RADIO'S GREATEST MAGAZINE

RADIO NEWS

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Edited by HUGO GERNSBACK

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COLUMBIA CHAIN ARTIST

EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE, NEW YORK

Cunningham RADIO TUBES

Take Notice of the marked improvement in your radio reception when new Cunningham Radio Tubes are performing their special tasks in the various sockets of your radio.

Don't use old tubes with new ones — use new Cunningham tubes throughout.

E. T. CUNNINGHAM, INC.
NEW YORK CHICAGO SAN FRANCISCO

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EARN $75.00 a week *in Your Spare Time*

JOINING the Radio Association enables you to cash in on Radio *now!* Follow its success-proven plans and you can earn $3 an hour, in your spare time, from the very first. Over $600,000,000 is being spent yearly for sets, supplies, service. You can get your share of this business and, at the same time, fit yourself for the big-pay opportunities in Radio.

Founded on a New Idea

Members of the Association do not wait for months before they make money out of Radio. Without quitting their jobs, our members are earning $25 to $75 a week spare time by building "tailored" radio sets, serving as "radio doctors," selling ready built sets and accessories, or following one of the many profit-making plans of the Association.

Earned $500 in Spare Hours

Hundreds earn $3 an hour as "radio doctors." Lyle Follick, Lansing, Mich., has already made $500 in spare time. Werner Eichler, Rochester, N. Y., is earning $50 a week for spare time. F. J. Buckley, Sedalia, Mo., is earning as much in spare time as he receives from his employer.

We will start you in business. Our cooperative plan gives the ambitious man his opportunity to establish himself. Many have followed this plan and established radio stores. Membership in the Association has increased the salaries of many. Scores are now connected with big radio organizations. Others have prosperous stores.

A year ago Claude De Grave knew nothing about Radio. Today he is on the staff of a famous radio manufacturer and an associate member of the Institute of Radio Engineers. He attributes his success to joining the Association. His income now is 350% more than when he joined.

What a Membership Can Do for You

1—Enable you to earn $3 an hour upwards in your spare time.

2—Train you to install, repair and build all kinds of sets.

3—Start you in business without capital, or finance an invention.

4—Train you for the $3,000 to $10,000 big-pay radio positions.

5—Help secure a better position at bigger pay for you.

6—Give you the backing of the Radio Association.

A MEMBERSHIP NEED NOT COST YOU A SINGLE CENT

Doubled Income in Six Months

"I attribute my success entirely to the Radio Association," writes W. E. Thon, Chicago, who was clerk in a hardware store before joining. We helped him secure the managership of a large store at a 220% increased salary.

"In 1922 I was a clerk," writes K. O. Benzing, McGregor, Ia., "when I enrolled. Since then I have built hundreds of sets—from 1-tube Regenerative to Superheterodynes. I am now operating my own store and my income is 200% greater than when I joined the Association. My entire success is due to the splendid help it gave."

Easiest Way Into Radio

If ambitious to become a Radio Engineer, to fit yourself for the $3,000 to $10,000 opportunities in Radio, join the Association. It gives you a comprehensive, practical and theoretical training and the benefit of our Employment Service. You earn while you learn. You have the privilege of buying radio supplies at wholesale. You have the Association behind you in carrying out your ambitions.

ACT NOW—if you wish Special Membership Plan

To a limited number of ambitious men, we will give Special Memberships that may not—need not—cost you a cent. To secure one, write today. We will send you details and also our book, "Your Opportunity in the Radio Industry." It will open your eyes to the money-making possibilities of Radio. Write today.

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4513 Ravenswood Ave.,
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Gentlemen:
Please send me by return mail full details of your Special Membership Plan and also copy of your book, "Your Opportunity in the Radio Industry."

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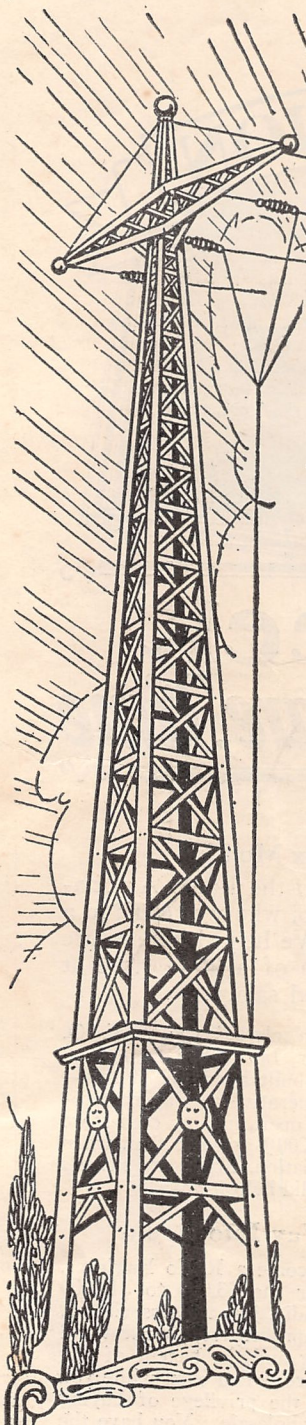

RADIO NEWS

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Scientists have demonstrated the lethal powers of extremely short wavelengths. The "Radio Gun" is envisioned as the military weapon of the future

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Some sound and practical advice on operating your radio receiver so as to obtain the most satisfactory musical performance from it.

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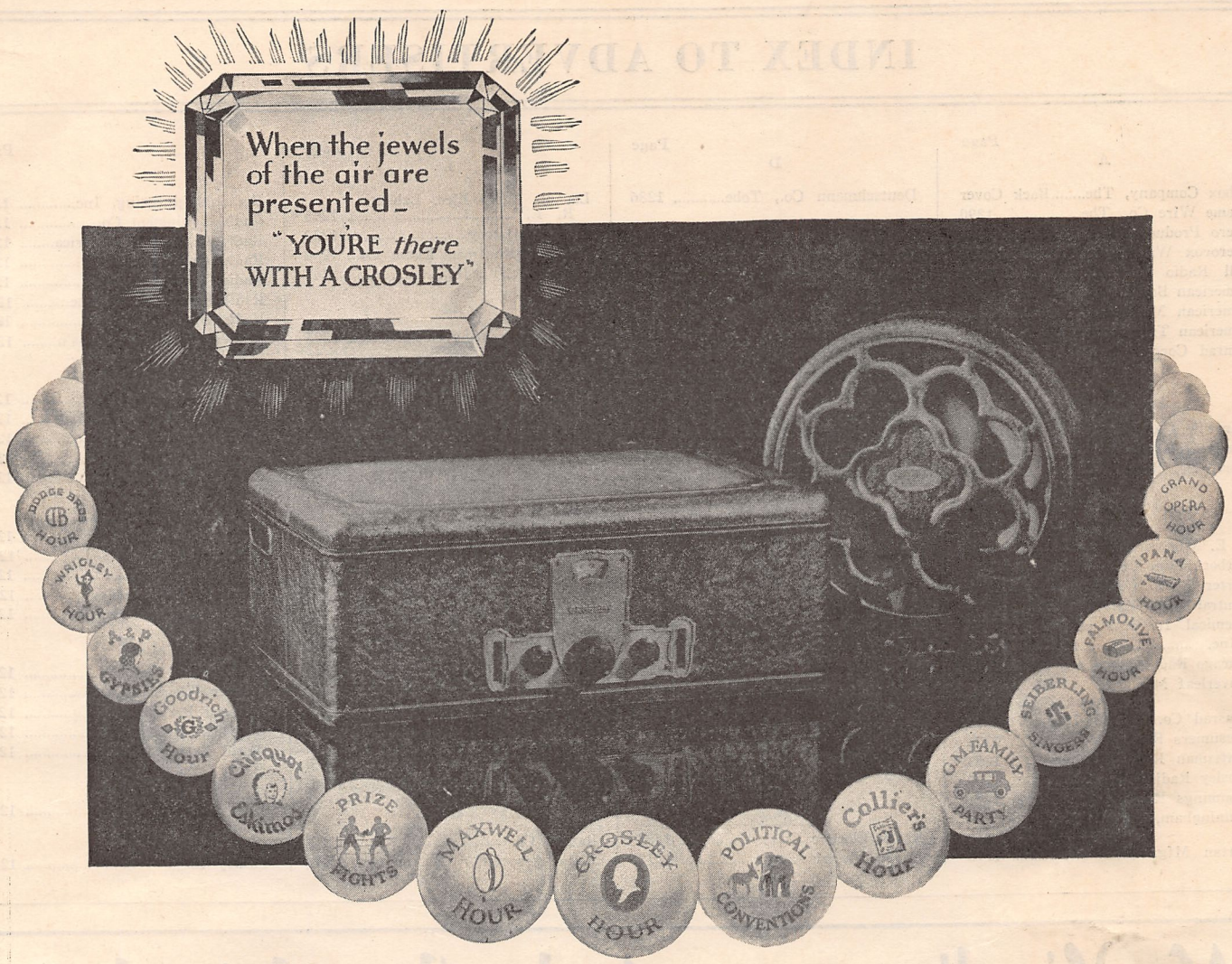

The New CROSLEY JEWELBOX

$95
WITHOUT TUBES

Take advantage of the most amazing offer ever made in all Radio History!

Try this remarkable new Crosley Radio with Crosley new type D Musicone without cost or obligation. Just phone a Crosley dealer—tell him you want to test the new Crosley Jewelbox.

Home is really the place to buy radio!

Home is where you can decide leisurely and surely. Crosley dealers are authorized to home demonstrate this new radio. Antenna unnecessary for such demonstrations—30 feet of wire on the floor of the room will do nicely.

Put the Jewelbox to any test!

Compare it with your old set. Try it with any other! Learn what radio reception *can* be. Note how easy it will be to break through any surrounding wall of local stations—to bring in distant programs quickly, clearly, and in full volume. Be sure you test the Jewelbox with the Crosley new type D Musicone that you may fully realize, if you own an old set or have not heard a Crosley, how far radio has progressed.
Remember—you do this all in your own home—at no cost and no obligation to you!

Buy Radio Reception—not Furniture!

The Jewelbox is a radio fine enough to go into the finest furniture you can buy and as such is easily installed—*but* it is distinctive, decorative, and desirable by itself. In Crosley radio you buy perfect reception and radio enjoyment first!

Try it in your home—that's the only way to buy a Radio!

Every Crosley Dealer is now authorized to give you this FREE trial!

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Powel Crosley, Jr., *Pres.* Cincinnati, Ohio

Licensed only for Radio Amateur, Experimental and Broadcast Reception.
Montana, Wyoming, Colorado, New Mexico and West prices slightly higher.

The Crosley Radio Corporation NEUTRODYNE

The Musicone finished to match the Jewelbox, $15

The new Crosley Jewelbox is self-contained to operate from light socket.

All in one beautiful case. Add tubes and it's ready to operate! It is powerful. Supplying 180 volts to power output tube it gives full undistorted volume. Other sets supplying 110 to 135 volts result in poor quality, distortion, and less volume.

The new Jewelbox is acutely selective.

The Acuminators, an exclusive Crosley feature enable you to tune sharply on distant stations, increasing signal strength and volume to a surprising degree.

The new Crosley Jewelbox is up-to-date.

The dial is illuminated—a modern necessary feature. The set is completely shielded as all high grade radios should be. The rich brown finish high-lighted with gold makes it an ornament to grace the finest room. The beauty of the Jewelbox will charm you.

The price of the new Jewelbox is a triumph of manufacturing genius!

Crosley engineers designed this new Crosley Jewelbox under explicit instructions to make first a perfect radio. If the production of their final design had been limited to a few hundred, only wealthy persons could have afforded them. But with efficient Crosley production methods, facilities to manufacture parts in million quantities, and a faith in the enormous demand such values would create, this splendid radio receiver is priced at $95.

Write Dept. 22 for literature.

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Remember—this is an encyclopedia—not a dictionary! It took over two years of intensive labor to compile it. It is the first Radio Encyclopedia ever published.

S. Gernsback's Radio Encyclopedia contains the meaning of every word and phrase used in the entire Radio Art. Every circuit, part and apparatus is thoroughly explained. A complete cross index is just one of the many features of this remarkable book.

There are 1,930 definitions—549 diagrams, photographs and drawings—all simple and easily understood. The book is nearly 1 inch thick and measures 9x11 inches.

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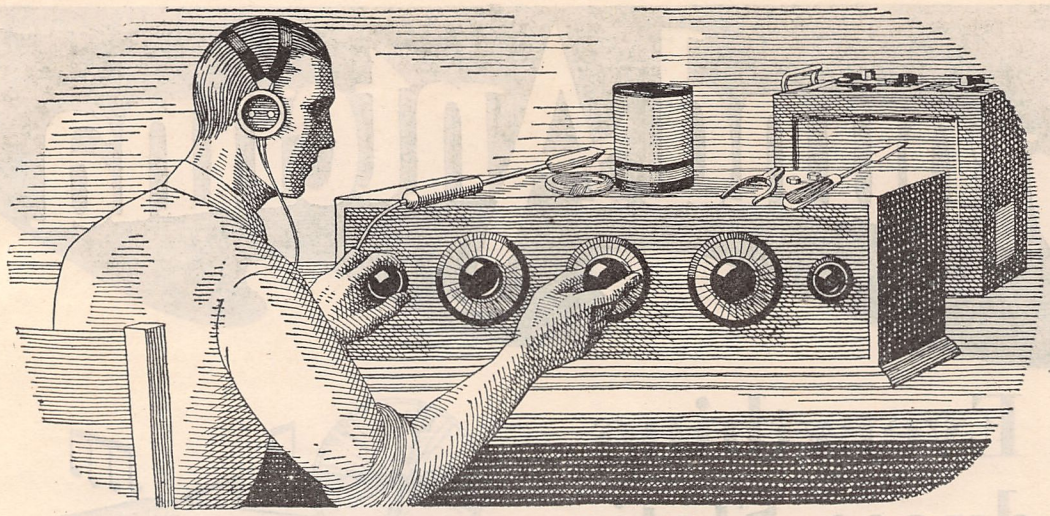

If all the Radio set I've "fooled" with in my time were piled on top of each other, they'd reach about halfway to Mars. The trouble with me was that I thought I knew so much about Radio that I really didn't know the first thing. I thought Radio was a plaything —that was all I could see in it for me.

I Thought Radio Was a Plaything

But Now My Eyes Are Opened, And I'm Making Over $100 a Week!

$50 a week! Man alive, just one year ago a salary that big would have been the height of my ambition.

Twelve months ago I was scrimping along on starvation wages, just barely making both ends meet. It was the same old story—a little job, a salary just as small as the job—while I myself had been dragging along in the rut so long I couldn't see over the sides.

If you'd told me a year ago that in twelve months' time I would be making $100 and more every week in the Radio business—whew! I know I'd have thought you were crazy. But that's the sort of money I'm pulling down right now—and in the future I expect even more. Why only today—

But I'm getting ahead of my story. I was hard up a year ago because I was kidding myself, that's all—not because I had to be. I could have been holding then the same sort of job I'm holding now, if I'd only been wise to myself. If you've fooled around with Radio, but never thought of it as a serious business, maybe you're in just the same boat I was. If so, you'll want to read how my eyes were opened for me.

When broadcasting first became the rage, several years ago, I first began my dabbling with the new art of Radio. I was "nuts" about the subject, like many thousands of other fellows all over the country. And no wonder! There's a fascination—something that grabs hold of a fellow—about twirling a little knob and suddenly listening to a voice speaking a thousand miles away! Twirling it a little more and listening to the mysterious dots and dashes of steamers far at sea. Even today I get a thrill from this strange force. In those days, many times I stayed up almost the whole night trying for DX. Many times I missed supper because I couldn't be dragged away from the latest circuit I was trying out.

I never seemed to get very far with it, though. I used to read the Radio magazines and occasionally a Radio book, but I never understood the subject very clearly, and lots of things I didn't see through at all.

So, up to a year ago, I was just a dabbler —I thought Radio was a plaything. I never realized what an enormous, fast-growing industry Radio had come to be—employing thousands and thousands of trained men. I usually stayed home in the evenings after work, because I didn't make enough money to go out very much. And generally during the evening I'd tinker a little with Radio—a set of my own or some friend's. I even made a little spare change this way, which helped a lot, but I didn't know enough to go very far with such work.

And as for the idea that a splendid Radio job might be mine, if I made a little effort to prepare for it—such an idea never entered my mind. When a friend suggested it to me one year ago, I laughed at him.

"You're kidding me," I said.

"I'm not," he replied. "Take a look at this ad."

He pointed to a page ad in a magazine, an advertisement I'd seen many times but just passed up without thinking, never dreaming it applied to me. This time I read the ad carefully. It told of many big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the Radio field, and how a man can prepare quickly and easily at home to take advantage of these opportunities. Well, it was a revelation to me. I read the book carefully, and when I finished it I made my decision.

What's happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months, I've had a Radio business of my own. At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business—such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd been wailing "I never had a chance!"

Now I'm making, as I told you before, over $100 a week. And I know the future holds even more, for Radio is one of the most progressive, fastest-growing businesses in the world today. And it's work that I like—work a man can get interested in.

Here's a real tip. You may not be as bad off as I was. But think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years—making the same money? If not, you'd better be doing something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, absorbing, well paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—No matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation —the book is free, and is gladly sent to anyone who wants to know about Radio. Just address J. E. Smith, President National R - dio Institute, Dept 5S, Washington, D. C.

J. E. SMITH, President,
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Dear Mr. Smith:

Please send me your 64-page free book, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no obligation, and that no salesman will call on me.

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Occupation.....

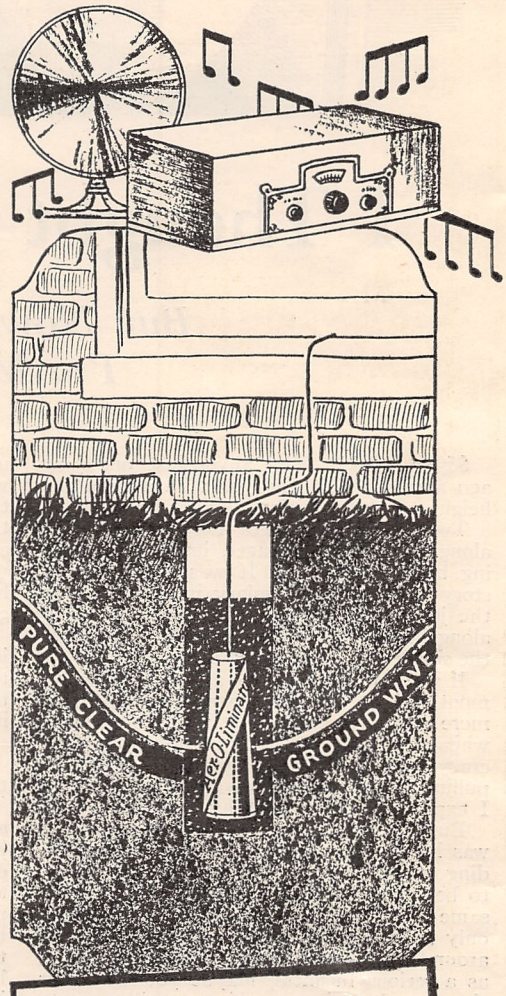
Amazing New Ground Antenna

Gets Everything—Reduces Static

Brings in Faraway Stations Loud and Clear Regardless of Static Conditions

Fans everywhere are replacing their troublesome and static gathering up-in-the-air aerials with the marvelous new GROUND ANTENNA—Aer-O-Liminator. Radio engineers and hundreds of users testify that Aer-O-Liminator gets better long distance reception, almost unbelievable freedom from outside noises, far greater selectivity and marvelously true, clear, sweet tone quality.

John E. Christenson, RADIO ENGINEER, CHICAGO, writes: "I have tested and thoroughly approve the Aer-O-Liminator. I find it increases selectivity and volume without distortion, practically eliminates static, gives good clear tones, both on local and distant stations. I would recommend the use of the Aer-O-Liminator to every radio owner to get the best reception from his set."



FREE TRIAL

Make this thrilling test at our risk!

Install an Aer-O-Liminator (Ground Antenna). Leave your old overhead aerial up. Try out on a night when static is bad. If you do not get a wonderful improvement in reduction from static, greater selectivity and clear, sweet tone without interfering noises, if you can't get good reception on stations that are drowned out by static on your old aerial, you need not pay us a red cent for this test. Send coupon at once for scientific explanation of Aer-O-Liminator (Ground Antenna), proof of performance, and our conclusive iron-bound guarantee, and remarkable Free Trial Offer—Mail Coupon TODAY!

EASY TO INSTALL

Just dig a small hole about 6 inches in diameter and drop Aer-O-Liminator into it.

CURTAN MFG. COMPANY
154 East Erie St., Dept. 827-G, Chicago, Ill.
Please send me at once complete description of Aer-O-Liminator, with details of guarantee, Scientific Proof, and Free Trial Offer.

Name.....
Address.....
City.....
State.....

Use this coupon

Aer-O-Liminator (Ground Antenna)

Endorsed by Foremost Engineers and Dealers

CURTAN MFG. COMPANY

Dept. 827-G, 154 East Erie Street, Chicago, Ill.

The three essentials for the fullest enjoyment of Summer Radio features!

SUMMER

fun with this powerful portable set!

MAKE THIS A RADIO SUMMER

Touring, camping, or at home, a portable Radio Receiver is a real summer enjoyment. It's convenient to carry, in your car, with your baggage, or if at home from room to room or out on the lawn.

You can build your own "portable" at a small cost—from a "Consrad" pattern which gives 4-page instruction booklet of parts needed, together with full size blueprints 16 inches wide by 20 inches high, of panel and wiring diagram.

The Consrad method is the simplest ever devised—you do not have to know anything about radio to follow it.

THIS CONSRAD PATTERN

50c—EVERYWHERE

Or send direct on receipt of 50c.

THE CONSRAD CO., Inc.
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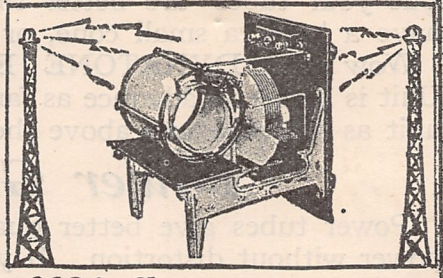
WHEN~~

stations crowd the air & spoil your programs



use a wave trap!

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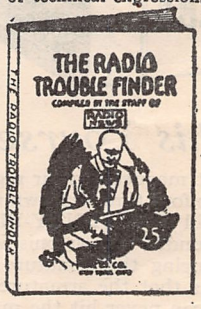

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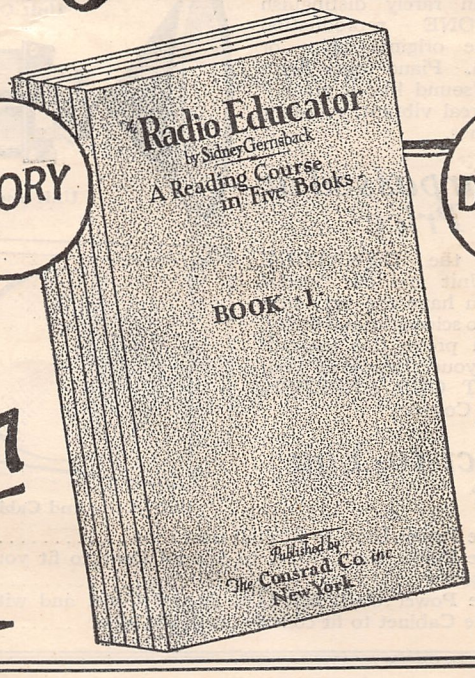

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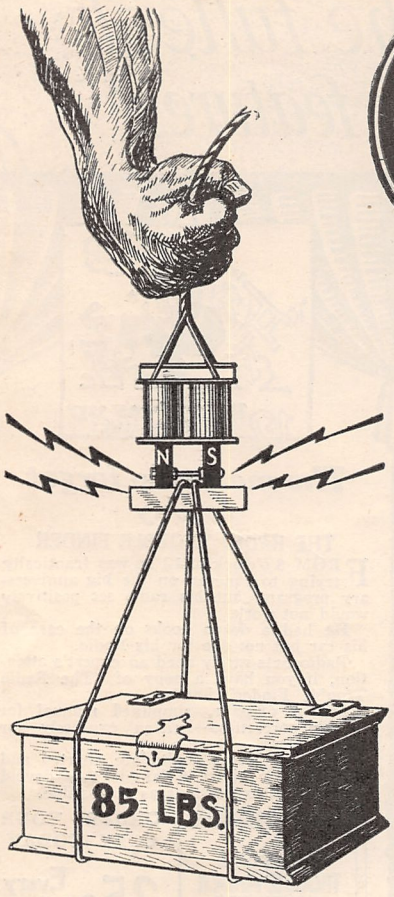

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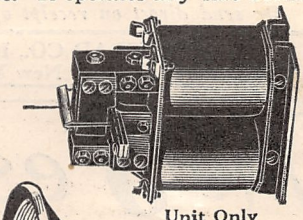
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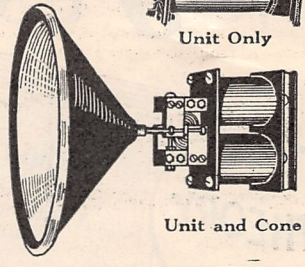
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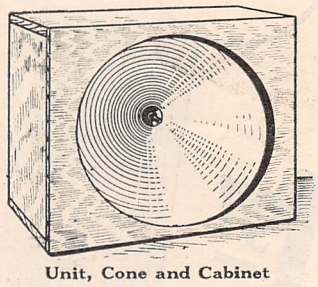
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Radio News

Hugo Gernsback Editor & Publisher

Editorial and General Offices, 230 Fifth Avenue, New York

Vol. 9 MAY, 1928 No. 11

A New Radio Cycle

By Hugo Gernsback

IF a thoughtful person were to review the history of radio, he would find that the art moves in certain cycles—in a definite wave-formation—which rise and fall with more or less constancy.

When radio first started, we had, at the transmitter end, the spark-coil and fixed-spark-gap cycle. This soon gave way to the cycle of the alternating-current transformer and the "quenched" or rotary spark-gap. At the receiver end, there was the coherer period, which coincided with that of the spark coil. The cumbersome coherer was soon superseded by the detector, for the period when we used electrolytic and crystal detectors. Then came the marvelously-versatile vacuum tube, which eliminated the previous receiving devices almost completely, and which caused only slightly less sweeping changes in transmitting apparatus. With the advent of broadcasting commenced a triumphant and as yet unchecked ascendency of the tube. The rise of the latter probably has not yet reached its zenith.

Previous to broadcasting, we had the loose-parts fashion, when a radio set consisted of various parts screwed to a bread-board or to the top of a table. Such a thing as a radio outfit complete in one box was not known; it did not appear until the advent of broadcasting created a demand for it. Then, immediately, the complete-set cycle started and gained headway. However, up to a year ago, we had not yet freed ourselves from some of the loose parts which had been in vogue since 1900. I refer to the power or battery system which supplies the operating energy for the radio receiver.

The battery cycle seems to have had a longer life than most of the others. It is true that the power-unit cycle started a few years ago, but this is already on the decline. The "A, B and C" power unit, operating from the electric-light socket, was designed to supplant all batteries and to furnish the same kind of power the latter had been generating. We will probably have such power units for many years to come; for the simple reason that there are millions of battery-tube sets in existence and a large proportion of them will certainly be equipped with such devices instead of being scrapped altogether in favor of A.C. receivers. But the external-power-unit cycle will probably not survive many years.

The ascendency of the alternating-current vacuum-tube cycle has been a tremendously sweeping one, and its vogue threatens to obliterate not only the battery cycle, but the eliminator cycle as well.

Right now, a new cycle, that of the *true* socket-operated set, is gaining headway. The socket-operated set uses vacuum tubes whose filaments work from the alternating house current. The complete "A and B" unit is no longer an "eliminator," but becomes an integral part of the set itself. That, of course, eliminates the "eliminator" itself. We already have the small, completely self-contained, so-called electric set, which requires no accessory other than a loud speaker. Everything else is contained within the set itself. Even the aerial and ground, the oldest survivors in the radio art, are now threatened with extinction, because you can use the electric-light system for both the aerial and ground. It is only a matter of time before our good old aerial masts will have vanished entirely from the housetops.

The advent of the modern alternating-current vacuum tube has left a great wreckage behind it; this tube has made obsolete the great majority of the old battery-operated sets, which will now be used only where there is no house current available. As far as the United States is concerned, that is true for only about 40% of the population; the other 60% of the houses are wired for electric current, and ready for socket-operated sets.

It is a curious fact that some of our largest set manufacturers are the greatest sufferers from the march of progress. When, late in 1927, it became necessary to make the switch from the battery set to the alternating-current-tube set, a number of manufacturers were left with huge stocks of battery-operated sets on their hands. They could not dispose of both types of these sets, any more than you could sell straw hats and fur overcoats in the same month; so a number of them had to take huge losses on great quantities of their battery sets. That is the cost of progress.

It is true that the radio industry is striving hard to stabilize itself, and every leader in the trade will tell you constantly that that has happened; but this assertion must also be taken with a grain of salt, because very few industries are ever stabilized. It was thus, and is thus, with the automobile industry, and it is thus with many other industries. No industry can hope to stand still while the world moves onward. It simply cannot be done.

How long the present new cycle will last, no one can foretell. If you took a consensus of opinion of the leaders of the radio industry, you would probably find that all are unanimous, that with the present alternating-current tubes and self-contained radio sets, the industry is now sufficiently stabilized for many years to come.

Frankly, I do not believe it. It has never happened in the past, and probably will not happen in the future. By all of this, I do not mean to say that, if you have any intention of buying a radio set today, you should wait to see what happens; that would be foolish. You keep on buying electric lamps and automobiles and phonographs whenever you want them; although you know very well that within a comparatively short time they will be obsolete. Radio is nowise different.

Yet it must be said, to the credit of the radio art, that the radio sets now in operation, which were built in 1925 and which are battery-operated, can still hold their own with the new sets. While there may not be a great market for them any more, they are still doing their work; just as many 1925-model automobiles, even though they have no four-wheel brakes and balloon tires, are still running and giving good service.

What will happen in the future and during the next cycle, no one can foretell exactly; but, for one thing, it is quite certain that during the next two years a new adjunct to radio's utility will come along in the form of television. You will have a television attachment, just as you have a loud speaker today. You will plug it in to your radio set at the same time you plug in your radio loud speaker; and you will see the distant events on your television 'screen' as you hear them on your loud speaker, both at the same time.

At first, the television accessory will be separate from the set; it will be sold separately. That will be one more cycle. Later on, no doubt, the television appliance will be built into the radio set, and we will then have a self-contained radio receiver with radio television, all operated from the house-lighting current.

At the present time, it would seem that the radio set will continue to decrease in dimensions. It will become smaller and smaller; at least as regards the console set. Of course, we will always have the radio set in its more elaborate make-up as fine furniture, but console sets will shrink in size during the next few years. Sets will become smaller and they will become simpler, with fewer things to get out of order, with greater refinements and with superior adjustments.

Whether the sets will always be tuned as we tune them now is to be doubted. Already, the push-button set has made its appearance; for local reception, you push a number of buttons and instantly you get the station indicated. For distance, you probably will tune the set of the future much as you do today; for locals, the tuning will be done almost automatically.

It is quite within the range of possibility that sets will be entirely automatic and will start operating daily at a predetermined time, switching themselves off automatically when the station goes off the air; only to be switched on again when a station goes on the air, if such should be desired. To be sure, you could still switch the set on and off by hand if you should wish to do so.

Then, too, there is always the chance that a totally-new discovery will come along that, in itself, will obliterate the vacuum tube in one way or another; and it is even within the bounds of possibility that there will be invented some new device that will require so little power that a small dry-cell battery will operate it for a considerable length of time. This, in turn, would again make the radio set independent of the lighting current and would make it more transportable. But all these things are yet in the future.

Mr. Hugo Gernsback speaks every Tuesday at 9.30 P. M. from Stations WRNY (326 meters) and 2XAL (30.90 meters) on various radio and scientific subjects.

Coming — A Program Pool?

Some Suggestions for a Method of Solving This Problem, which Has Vexed the Entire Radio Industry Since the Beginning

By Charles Magee Adams

FINANCING is still one of broadcasting's major unsolved problems. This statement doubtless comes as somewhat of a surprise to most listeners, and for reasons altogether understandable. Technical developments, the evolution of programs, and the frequency-allocation difficulty have absorbed popular attention to the virtual exclusion of financing; and, even when this has been thought of by those at the loud speaker, the comforting assurance that nearly 700 stations are managing to meet their operating expenses "somehow or other" has served to allay concern.

Nevertheless, the fact remains that financing is not only one of the really grave problems confronting broadcasting, but the one perhaps farthest from permanent solution (with special emphasis on *permanent,* since a history of the subject down to the present day discloses a succession of merely partial and makeshift solutions.)

A MODEST BEGINNING

When broadcasting came into being back in 1921, it was assumed that its then trifling cost would be met by listeners through the purchase of receiving equipment from the radio manufacturers supplying programs—an arrangement which seemed admirable. It was practicable because the handful of pioneer stations were owned by the few radio manufacturers of that day. It was painless, as compared with the license fee system adopted in Europe, since the cost was levied indirectly; and fair in that the cost borne by each listener was roughly proportional to the amount of reception. But the plan had hardly been outlined before it was complicated—not to say upset—by the entrance of numerous non-radio interests into the field of broadcasting.

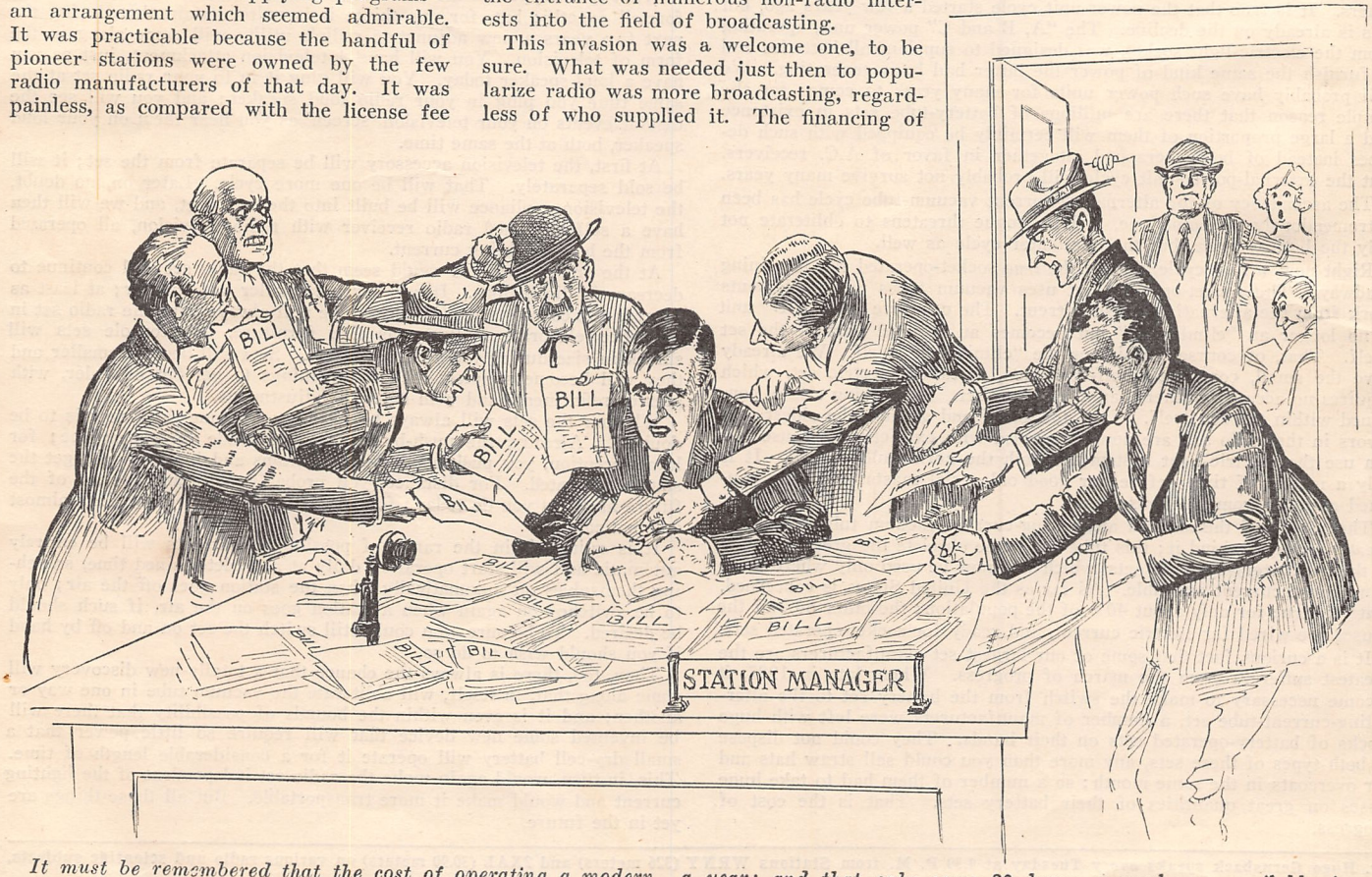
SOME years ago an eminent electrical scientist, Dr. Benjamin Franklin, assured his associates that, if they did not all hang together, they would assuredly hang separately. A prospect of this kind for radio producers seems to be envisaged by the writer of this article, who is an impartial observer of long experience in the radio field. It is his belief that a close union of the radio industry, for the purpose of supporting broadcasting in better style, is quite feasible and the next logical step. We shall be glad to learn the mental reactions of our readers, not only those in the industry and engaged in broadcasting, but also those on the outside, merely listening in.—EDITOR.

This invasion was a welcome one, to be sure. What was needed just then to popularize radio was more broadcasting, regardless of who supplied it. The financing of the newcomers' operations, too, was along sound lines. In return for their broadcasting they secured the good will of the audience. But the result, on the support of broadcasting as a whole, was to put it on a composite, and more or less confused, basis. Radio manufacturers continued to recoup their outlay for broadcasting through the sale of receiving equipment, while the non-radio interests depended on good will.

Then, while these two dissimilar plans were engaged in adjusting themselves to each other, came still a third complication—advertising.

THE COMMERCIAL PROGRAM

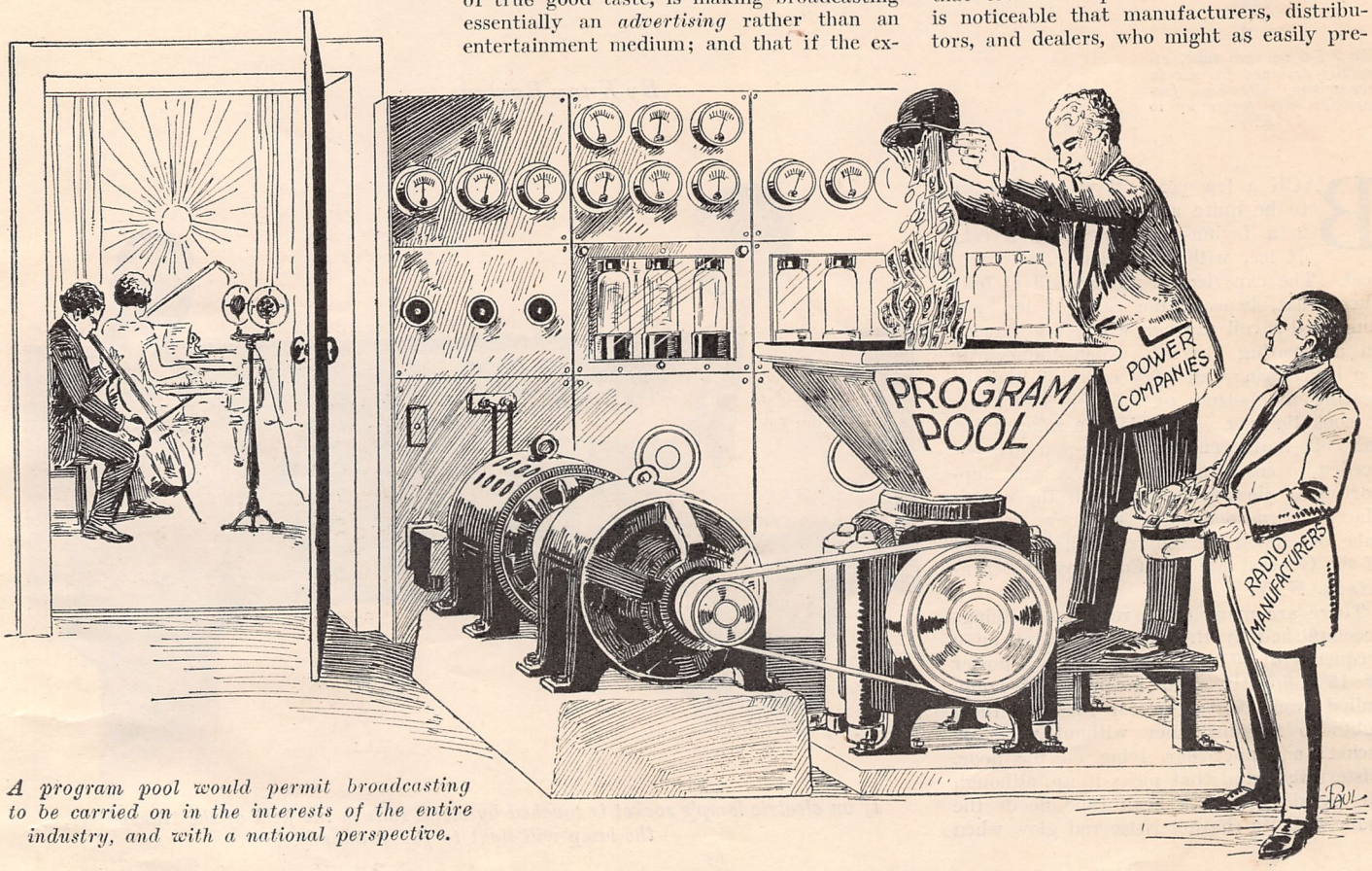
Again the results justified the innovation, for the moment. The cost of operating stations had been mounting so rapidly that owners were receptive to any expedient which offered partial relief from the increasing burden. Many interests, both radio and non-radio, which did not own stations, wished to secure good will through broadcasting; and the additional revenues from commercial programs, which were the result, played no small part in the subsequent development of the art. Once more, how-



It must be remembered that the cost of operating a modern station, of even 5000 watts, is in the neighborhood of $100,000 a year; and that only some 30 hours a week are available for sale, to defray the mounting expenses of continuous operation.

ever, the effect on broadcasting's financial basis was still greater confusion—continuing down to the present day.

A survey of the field as things now stand reveals the following situation: a few stations are owned by radio manufacturers, who finance their operation wholly by the sale of receiving equipment; a few are operated by non-radio interests, recouping their entire outlay through good will secured by programs; and an overwhelming majority of them are owned by both radio and non-radio



A program pool would permit broadcasting to be carried on in the interests of the entire industry, and with a national perspective.

interests, financing themselves in part by the sale of receiving equipment or through good will, and in part by the sale of time on the air to other interests, radio and non-radio. This involved and haphazard arrangement *seems* to be succeeding in spite of its manifest lack of definite policy or coherence.

"Seems" deserves all the emphasis that can be given it. It is assumed by most listeners that the development of the commercial program in particular has virtually solved the problem of financing broadcasting. Accounts of the impressive sums paid for time on the air suggest that stations reap not only a handsome revenue, but a comfortable profit from this source. But the facts are quite to the contrary.

NOT A BONANZA

A man, whose long experience and intimate contact with broadcasting from the inside make his statements carry the weight of authority, informs the writer that, far from showing a profit, even those stations which sell a maximum of their time on the air still operate at a loss. Further, and more significant, there is the fact that the National Broadcasting Company, the largest and most successful agency for commercial program dissemination, shows an annual deficit of more than $2,000,000; and this is not difficult to grasp when it is remembered that the cost of operating a modern station of even 5,000 watts is in the neighborhood of $100,000 a year, exclusive of artists fees, and that only some 30 hours a week are available for sale.

So it is obvious that the commercial program, now relied on most heavily, has not only failed as a solution of broadcasting's financial problem, but offers little, if any, hope for further relief. Listeners are remarking that the predominance of the sponsored feature, even in its present quantities, and when it is kept within the bounds of true good taste, is making broadcasting essentially an *advertising* rather than an entertainment medium; and that if the expansion of this advertising plan continues radio will lose much of its appeal to the public. Advertisers, too, are indicating that the rates charged for time on the air are already all the traffic can profitably bear.

The situation today accordingly is this: only the few largest radio and non-radio interests are strong enough to supply modern broadcasting single-handed, and further development of the commercial program as a means of distributing the burden seems inadvisable; which would make it appear that the present haphazard method of financing can scarcely be relied on to carry the increasing load the future will inevitably bring to broadcasting.

At the same time, analysis discloses certain trends which, if they follow their indicated course, may well develop a sound and permanently satisfactory solution of the difficulty.

BROADCASTING VITAL TO RADIO

First—even a cursory survey reveals that, of all the diverse industries now engaged in national and near-national broadcasting, the radio industry leads by a comfortable margin; also that there has been a steady increase in the amount of such broadcasting, particularly by manufacturers, distributors, and even dealers employing single stations; and the reasons are not far to seek.

To non-radio interests, broadcasting is at best merely a publicity medium; valuable, to be sure, but only as such. Curtailment or even suspension of the service could easily be compensated by increased use of some other medium. To radio interests, on the other hand, broadcasting is their lifeblood. Without it there can be no radio industry, and even its curtailment carries a serious threat. Hence the increasing efforts of radio interests to build up broadcasting.

This explains the second current trend—that toward cooperative broadcasting. It is noticeable that manufacturers, distributors, and dealers, who might as easily present small individual programs, are finding it to their common advantage to furnish more pretentious features under the auspices of their trade bodies. The same idea, further developed, also appears in the proposal for national programs provided by national trade associations of the industry. This may infuse new life into the suggestion of a comprehensive program pool, made some four or five years ago.

At the time it was brought forward, this plan contemplated the general financing of broadcasting through a common fund collected from all the varied interests benefitting from broadcasting. It failed to progress beyond the status of a suggestion for several reasons.

The component interests of the industry were too far apart to make such a high order of cooperation practicable at that time; and other methods of financing—notably the commercial program, just then developing—held out promise of a solution along different lines. But in view of the failure of these methods, and more especially in the light of the two trends just noted, there now seems ample justification for reconsidering the possibilities of the pooling plan; the more because of still another development—the Radio Corporation's licensing policy.

(*Continued on page* 1262)

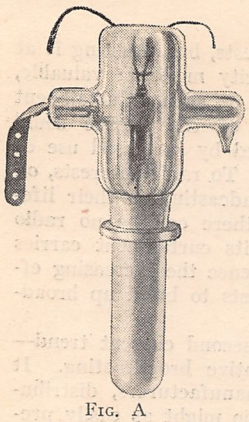


FIG. A

The ZT-6 vacuum tube, especially designed for use in transmitting ultra-high frequencies with power up to 15 K.W.

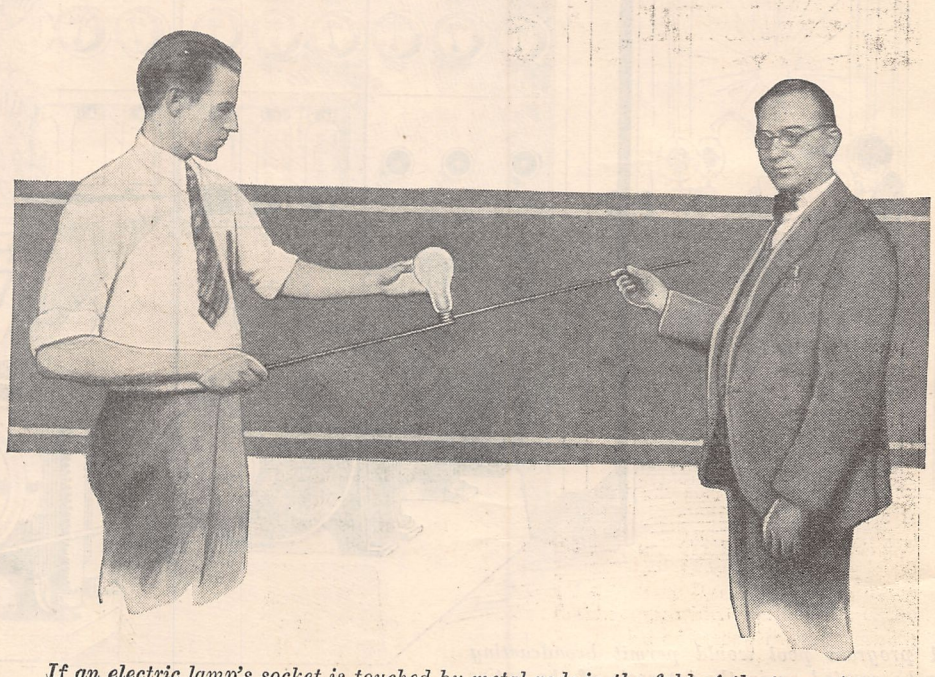
High-Frequency Magic in the Radio Laboratory

Description of the Latest Experiments with A New Short-Wave Vacuum Tube Using a Power of 15 Kilowatts

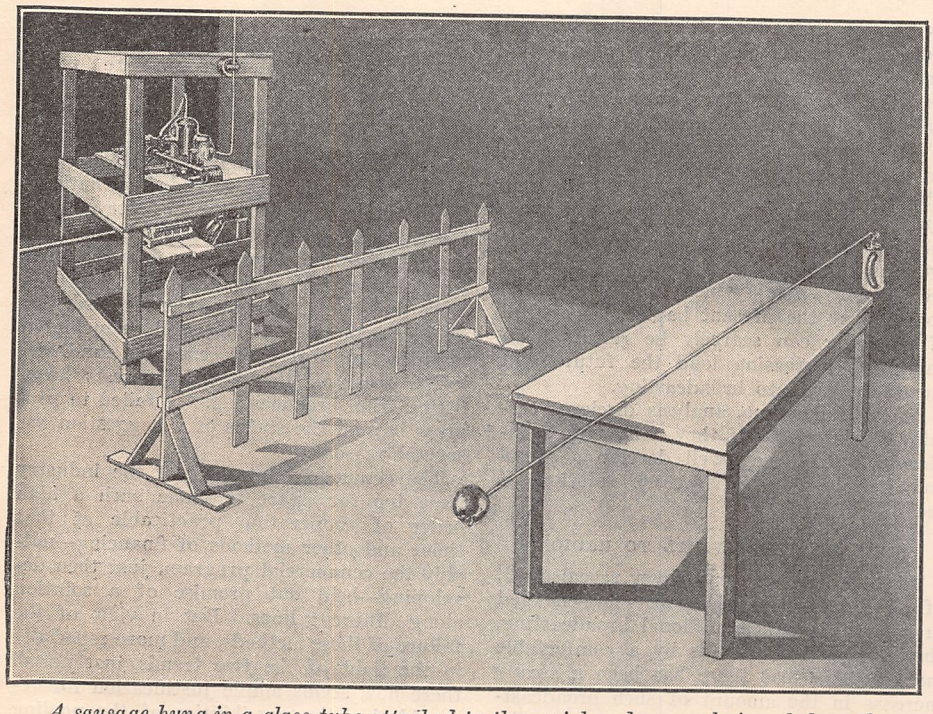
By Knox Baxter

BACK a few years, it was considered to be quite a feat to cook an egg in a frying-pan, placed on a cake of ice, without a visible source of heat. The experienced reader will at once guess that, beneath the cake of ice, was concealed a coil through which was flowing an alternating current, which induced in the iron frying-pan *eddy currents,* thereby heating the bottom of the pan sufficiently to cook the egg. But now the cake of ice, the coil, and even the frying-pan are not needed to cook an egg. Just a wire supporting a glass tube, in which the egg is placed, is needed—plus the new vacuum tube developed by the research laboratory of the General Electric Company at Schenectady, N. Y.

There are many other remarkable things accomplished by this tube, operating on a frequency of 50,000 kilocycles with a power of 15 kilowatts. An incandescent lamp, pulled from its carton for the first time, lights to full brilliancy without wires or socket; a copper bar, lying on the floor, blisters the hand that picks it up, although the metal is cold; a neon tube floods the room with its characteristic red glow when it is merely touched by someone's hand; electrical meters in adjacent rooms run wild, and delicate instruments are twisted or broken, so that all scientific measuring work in the vicinity of the operating tube is impossible.



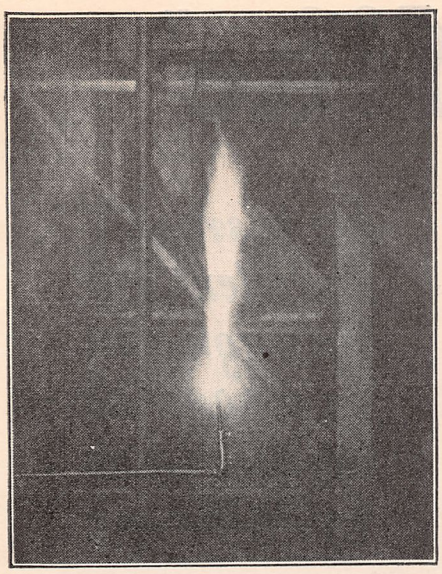
If an electric lamp's socket is touched by metal rods in the field of the transmitter, the lamp will light to full brilliancy.



A sausage hung in a glass tube attached to the aerial and an apple impaled on the aerial can be thoroughly cooked by the power transmitted from the 6-meter tube, at a considerable distance.

The source of all these phenomena is a large, innocent-looking vacuum tube about five inches in diameter and two feet in length (See Fig. A), placed in a framework of wood, which carries also a number of meters, coils, resistors and wires (See Fig. B). The tube operates as a self-excited oscillator on a wavelength of six meters and is capable of radiating from ten to fifteen kilowatts, or probably fifty times as much as any other ultra short-wave tube has yet been able to generate. The tube is connected through a coupling system to a copper bar approximately three meters (10 feet) long, and is able to radiate into space practically the full fifteen kilowatts generated by the oscillator.

This tube exemplifies no new principle and it should be remembered that it has lately been comparatively simple to produce very high frequencies at low power. But this recent demonstration comes at the first time that it has been possible to combine the ultra-high frequencies with the high power hitherto available only for the longer wavelengths, and to obtain a resultant high-



An unretouched photograph of the "standing electric arc," which gives an idea of the vast power the ZT-6 tube can set at large.

powered output on the short wavelengths in one tube. As yet, however, no method has been devised to control the generated frequency within the close limits required by commercial transmission.

100 degrees F., in about fifteen minutes; after which the experiment was discontinued.

Dr. W. R. Whitney, director of the G. E. research laboratory, states, "It may be assumed that, if we had a perfectly harmless method for warming the blood, it might be of medical value; because fevers are sometimes artificially produced in order to start convalescence, and it may well be, as asserted, that raised blood temperature, or fever, is one of Nature's factors in recovery from infectious diseases."

As mentioned at the beginning of this article, one of the most unusual experiments possible with this high-frequency tube is "radio cooking." An insulated wire was suspended over a table, at some distance from the radiating aerial and parallel to it. A sausage was placed in a glass tube, which was hung from the end of this receiving aerial and, in a few minutes, the sausage started steaming, showing that it was being cooked. When the meat was removed from the glass tube it was found that the "hot dog" had been cooked by the high-frequency currents that had been induced in it, and was pronounced to be every bit as tasty as any ever eaten. An apple was strung on the end of the aerial wire and, in a short time, was thoroughly cooked to the very core. With a slightly

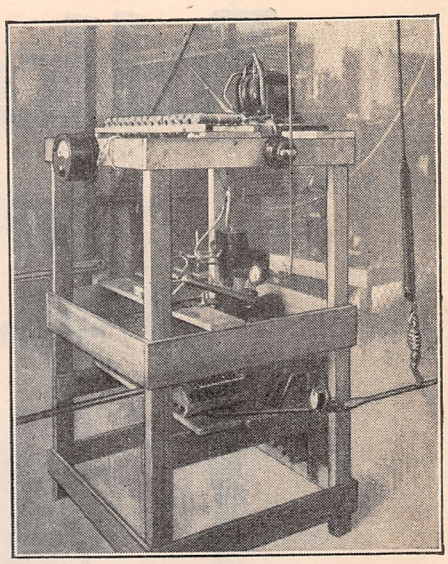
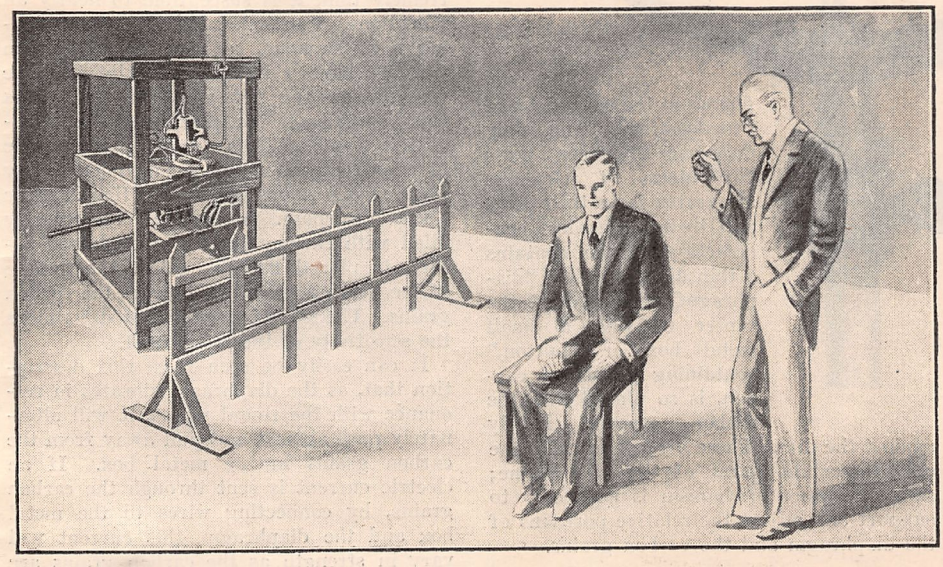


Fig. B—The 6-meter-tube transmitter. The antenna may be seen attached by the insulator on the side and standing straight up.

different hook-up, cookies have been baked and water boiled by the induced currents. The fact, that only a small fraction of the 20 horsepower delivered by the radiating system went into this cooking, detracts not at all from its novelty.



When a man remains for about fifteen minutes within six feet of the transmitter operating on 6 meters, his body temperature is raised 1.5 degrees from the normal of 98.5, or to a heat approaching fever.

PHYSIOLOGICAL EFFECTS

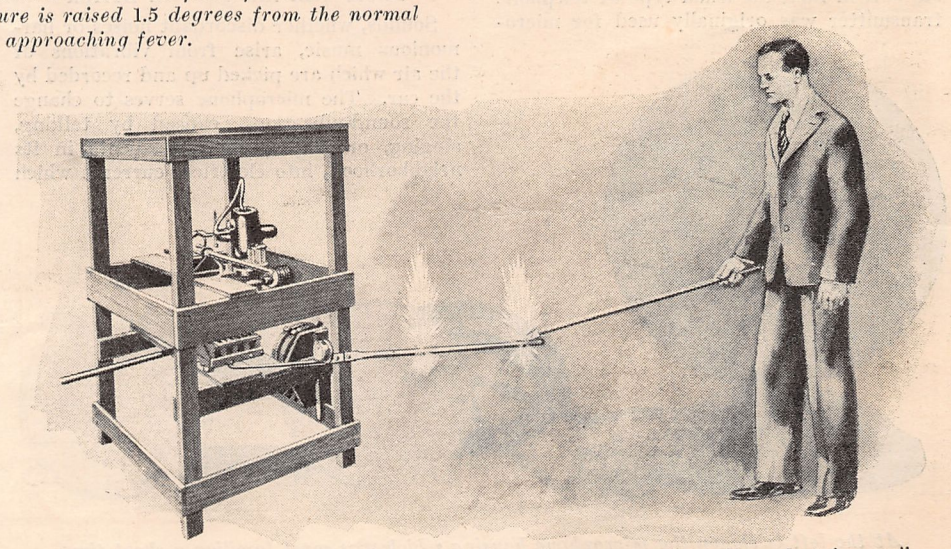
Several very interesting physiological effects have been observed in connection with the new tube, which is designated by the figures ZT-6. The effects on fruit flies and rats of the field set up by this tube are very remarkable, and, at the present time, cats are being experimented upon. At a frequency of approximately 50 million cycles, a salty solution (which is a conductor of electricity) can be heated in a glass tube placed very close to the high-frequency generator, and, at approximately this frequency, *the salt solution corresponding in strength to blood serum is heated most.*

Men who have been working near the apparatus have noticed distinct warming effects, which increased as they neared the tube. Different experiments were performed and it was discovered that the body temperature could be increased to nearly

POWER THROUGH SPACE

One of the most spectacular effects of the demonstration of the short-wave generator is the "standing electric arc," which is an excellent imitation of the famous ball of fire said to accompany tropical thunderstorms. An operator touches the end of the radiating aerial with a metal-tipped rod, and immediately a greenish-white arc rises to a height of more than a foot. When the metal-tipped rod is removed the arc remains sputtering and sending molten copper in all directions. By skillful manipulation as many as three of these arcs have been established simultaneously along the aerial, giving the appearance of a series of flaming gas jets. It is difficult to imagine a more extraordinary sight than a powerful electric arc, representing thousands of volts, *standing entirely by itself*

(*Continued on page* 1276)

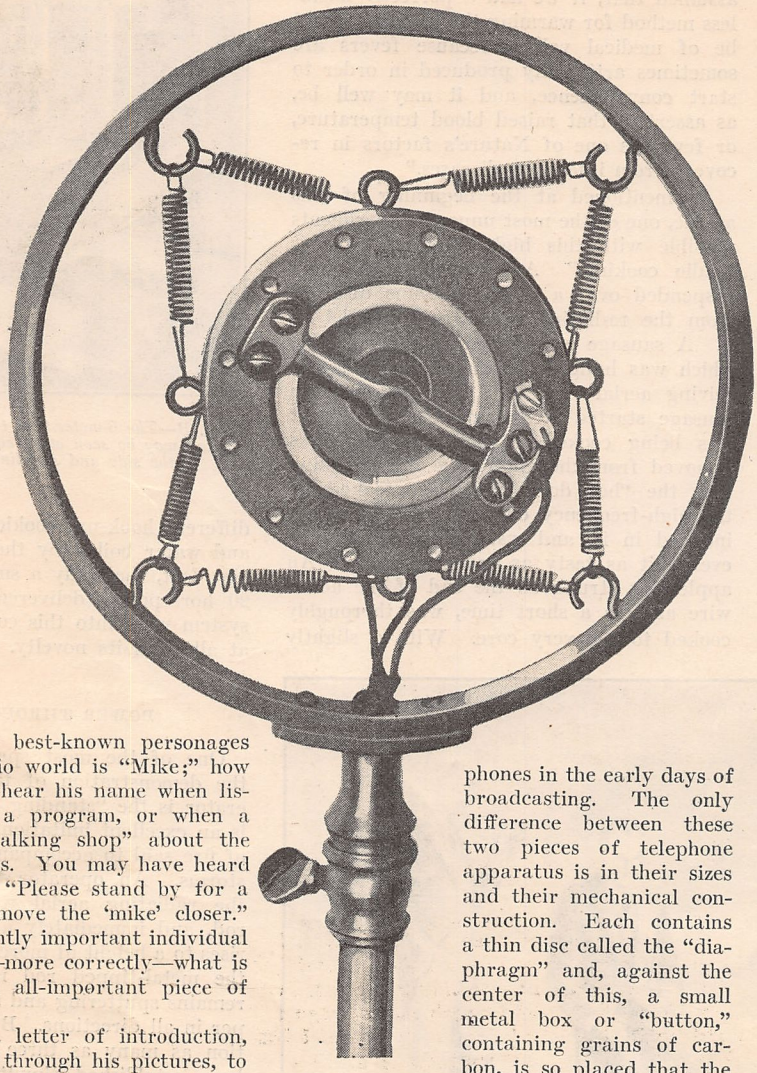


If a metal-tipped wooden rod be touched to the antenna, "standing electric arcs" will be established and will flame after the rod is removed. This can be done on a receiving aerial also.

Folks-Meet "Mike"

He is small and silent, but through him you hear the radio programs.

by C. W. Palmer



A front view of the "studio type" of microphone now employed almost exclusively in American broadcast stations; the spring suspension is clearly shown.

ONE of the best-known personages in the radio world is "Mike;" how often you hear his name when listening to a program, or when a radio expert is "talking shop" about the quality of programs. You may have heard the announcer say "Please stand by for a moment until we move the 'mike' closer." Who is this apparently important individual named "Mike," or—more correctly—what is the nature of this all-important piece of radio apparatus?

This article is a letter of introduction, presenting "Mike," through his pictures, to his many friends in the radio audience. You have often used a telephone, and are most familiar with the mouthpiece, otherwise known as the "transmitter," into which you talk. This, electrically, is exactly the same as the microphone used to pick up programs and speeches at the broadcast station; in fact, the usual type of telephon transmitter was originally used for microphones in the early days of broadcasting. The only difference between these two pieces of telephone apparatus is in their sizes and their mechanical construction. Each contains a thin disc called the "diaphragm" and, against the center of this, a small metal box or "button," containing grains of carbon, is so placed that the carbon presses lightly against the disc. These are, electrically, the only important parts of the microphone; since the other mechanism is used only to support and adjust the relative positions of the diaphragm and the carbon grains.

FROM THE AIR TO THE ETHER

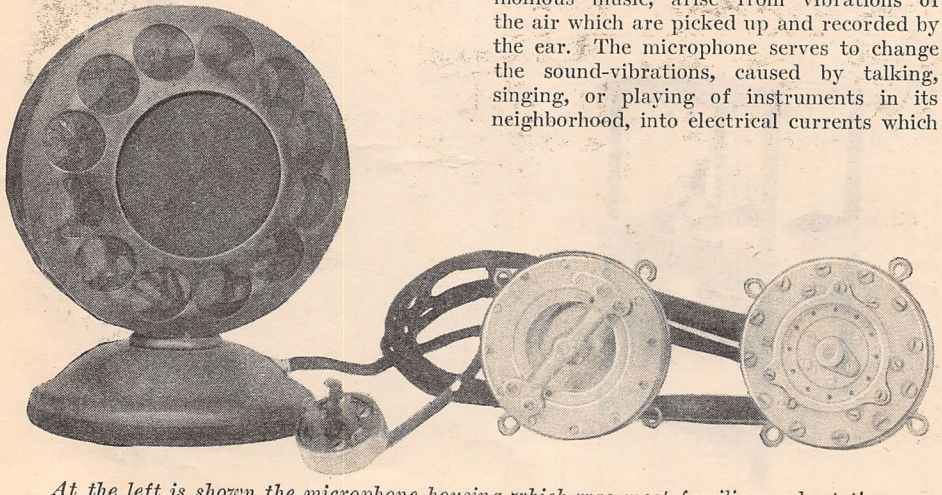
Sounds, whether discordant noises or harmonious music, arise from vibrations of the air which are picked up and recorded by the ear. The microphone serves to change the sound-vibrations, caused by talking, singing, or playing of instruments in its neighborhood, into electrical currents which vary according to the sound which is being transmitted. In the transmission of voice and other sounds, either over the telephone wires or by radio, the sound-vibrations first strike the thin disc (or diaphragm, as it is called) of the telephone transmitter or the microphone, and cause it to vibrate.

Since the microphone's diaphragm is extremely thin, it is susceptible to nearly all vibrations. Care must be taken, in designing a microphone, so that the diaphragm will not have a tendency to vibrate more strongly on one note than on others; as this would spoil the *quality* of the transmitted signals. This tendency to vibrate in resonance with sound-vibrations of any pitch makes it possible to use this disc for a useful purpose. A small metal box partly filled with carbon grains, as explained before, is placed lightly against the middle of the diaphragm, which touches the carbon grains. The size of these grains determines the sensitivity of the instrument.

It can easily be seen from this description that, as the diaphragm vibrates in resonance with the sound waves, it will alternately push against and pull away from the carbon grains in the metal box. If an electric current is sent through the carbon grains, by connecting wires to the metal box and the diaphragm, this current will vary in strength as the carbon grains are compressed and released; since this compression and expansion causes a change in the *resistance* of the circuit. When the carbon grains are tightly compressed, more current can flow than when they are free; as the points of contact are larger—a principle used in making "rheostats." (See Fig. 1.) Thus it can be seen that the sound-vibrations, causing the diaphragm to vibrate, cause a corresponding electrical vibration in the circuit to which the microphone is connected. These fluctuating electrical currents are used in conjunction with other apparatus, either to transmit the messages over wires, in the case of the telephone; or through the "ether," in the case of the radio.

CONSTRUCTION OF THE MIKE

Several illustrations of microphones used in radio transmission are shown on these pages. The standard microphone used by practically all American broadcast stations measures 3¼ inches across the microphone itself, and is supported in a frame 6 inches in diameter. As you will notice, it is sup-



At the left is shown the microphone housing which was most familiar a short time ago, and is still used frequently for outside work. At the right, the "works" of two such "mikes," showing the front and back surfaces.

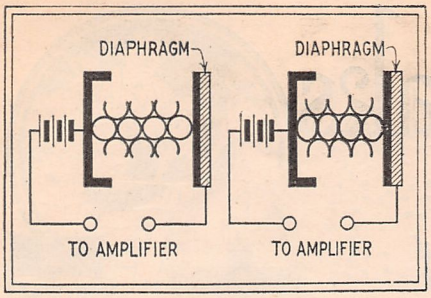


FIG. 1

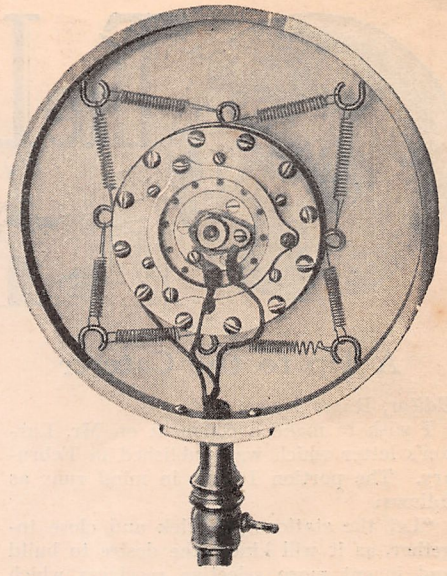
The action of the carbon "button" is shown here in greatly-exaggerated form. The resistance decreases as the contacts flatten out.

ported on four springs so that mechanical vibrations cannot affect the quality by introducing rasping noises, etc., which might be caused by mechanical vibration of the supporting frame.

The large illustration at the bottom of this page shows one of these microphones, cut away so its that internal construction can be seen. In this case, two carbon buttons or boxes containing carbon grains are used, one at the front and one at the back of the diaphragm. The parts of this microphone are lettered and are as follows: A, the bridge which supports the front carbon "button," or box holding the carbon grains; B, the clamping plates which serve to hold the diaphragm firmly in place; C, the diaphragm; D, the front carbon button; E, the rear button; F, the small carbon grains; G, paper rings or gaskets which are used to hold the carbon grains in the box, while permitting a free vibration of the diaphragm; H, the rings which hold the paper gaskets in place.

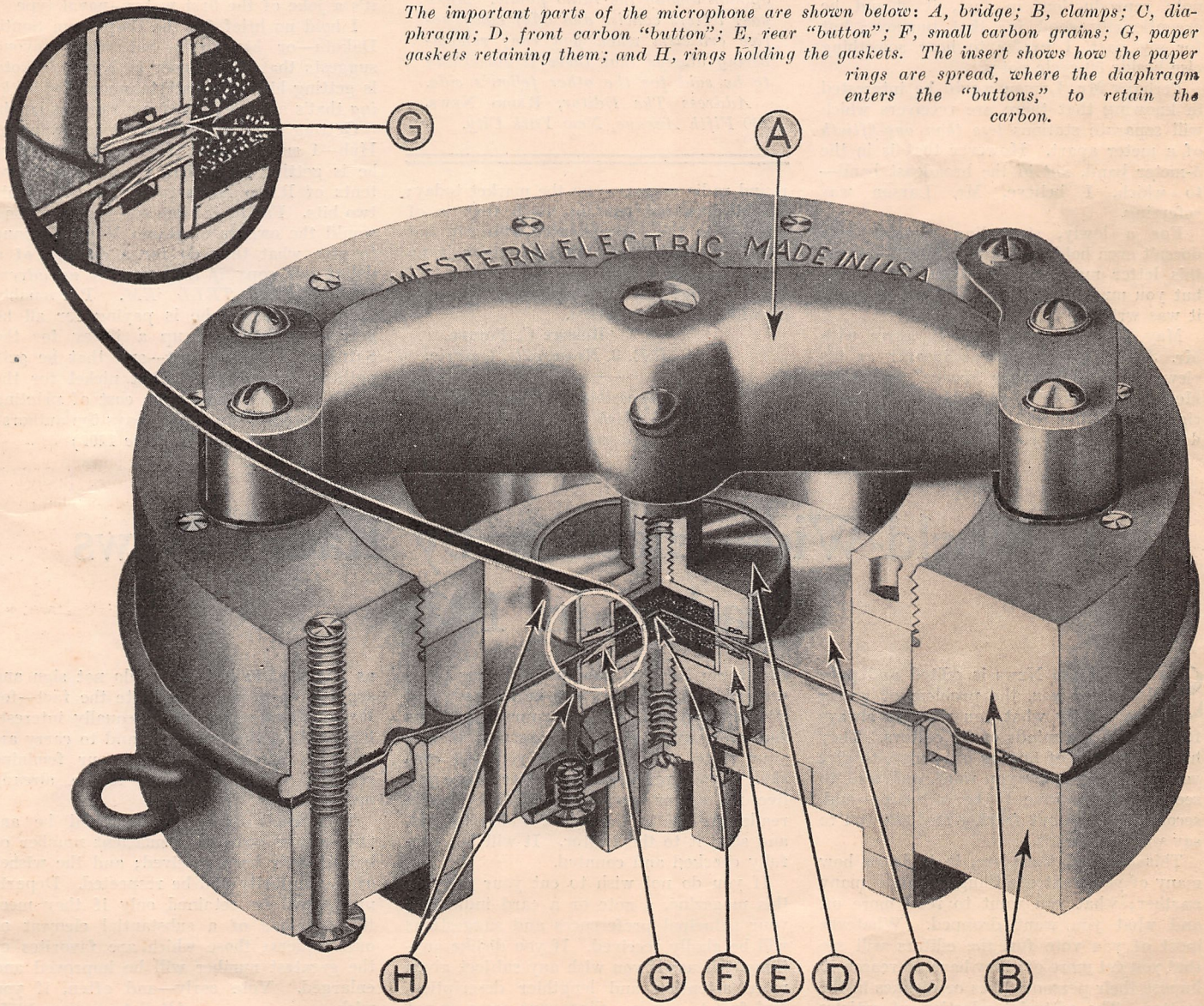
The metal used in the diaphragm of this transmitter is an alloy of aluminum which supplies both strength, lightness and flexibility. The disc is about .002-inch thick or slightly heavier—about as thick as a good grade of tissue paper. This metal sheet is stretched in the frame or clamping rings, so that it will be perfectly flat. The carbon grains in this type of microphone are quite small, since great sensitivity is required.

Well, folks, you now know just who "Mike" is and what he is used for. When the announcer says "Please stand by for a moment until we move the mike closer," you will know that the distance between the microphone and the artist is too great to permit the sounds to be picked up correctly and it is necessary to move the microphone. The wires running to the microphone are, almost always, equipped with a switch; so that the announcer can disconnect the microphone from the circuit when the musicians are tuning and when it is necessary to shift the microphone to another point in the studio. This is the reason why you do not hear the announcer, in a well-managed studio, anxiously request the name of the next selection, or excitedly explain that the bass viol is out of tune, making the transmission sound "terrible."



The back view of the studio microphone is shown here; the mounting screws and the terminals for connecting wires are located on this side.

The important parts of the microphone are shown below: A, bridge; B, clamps; C, diaphragm; D, front carbon "button"; E, rear "button"; F, small carbon grains; G, paper gaskets retaining them; and H, rings holding the gaskets. The insert shows how the paper rings are spread, where the diaphragm enters the "buttons," to retain the carbon.



A Tip to the Caterer

Editor, Radio News:

I wish to make a comment on Mr. Larson's letter which was published in February. The portion I have in mind runs as follows:

"Let the stations be thick and close together, as it will kindle the desire to build and invent more selective receivers which will in time be able to tune them in and out to the tenth and fiftieth of a meter.—"

Mr. Larson signs himself as being of the Naval Radio Station at Guantanamo Bay, Cuba. For a radio man he shows either a lack of knowledge or a superabundance of thoughtlessness. A little thought will show anyone that a receiver so selective as the ones he expresses himself as desiring would cut sidebands to the nth degree. I suppose that it would be all right for bass-note reproduction, in fact, it should be exceptionally good for that purpose; but for my part, I prefer to hear something else beside 30-cycle notes.

Perhaps Mr. Larson would be interested in knowing that there are receivers which will separate stations *less than one-fiftieth* of a meter apart. However that is in the 5-meter band, *not* in the broadcast band—to which, I believe, Mr. Larson was referring.

For a lowly, struggling servicer who doesn't even hold an amateur "op's" license, this letter may sound a trifle "high-hat," but you must take it in the spirit in which it was written.

May I state that I entirely agree with Mr. J. E. Kitchin except insofar as his views on "The Listener Speaks" and "The Home Constructor" go. He is doggone right about the rest of the magazine. I don't like the type you used in the February issue because it is too hard on my eyes. Other people may like it but not Robert C. Potter.

Like Mr. Larson, I realize that you are, no doubt, catering to the majority.

Even *QST* is becoming femininized. The only thing that is not is *The Proceedings of the I.R.E.* and I hope they never will be.

I will say that Radio News is the best all-round radio magazine on the market today; but it does not contain much that is of interest to the experimenter who can not afford a transmitter. In fact, there is no magazine that does.

I hope that this will be taken in the spirit in which it was written.

Robert C. Potter,
R.R. 3, Beamsville, Ontario.

(It is not impossible that receivers will yet be invented which will tune successfully to the fiftieth of a meter in the broadcast band. The best of inventive minds are working on the problem. As for the type in which Radio News *is now printed, it was selected especially for its legibility. If other readers agree with Mr. Potter, we shall be glad to hear from them. This is* your *magazine, and we want you to feel free to criticise it whenever you see an opportunity to do so. Brickbats will be received cheerfully, as well as bouquets.* —Editor.)

THIS page belongs to the readers of Radio News. *It is theirs for the purpose of discussing fairly and frankly the needs of broadcasting from the standpoint of the great public who listen in. The letters represent, not necessarily the editorial opinion, but that of the writers; who are, in the editorial belief, fairly typical of groups of opinion among the radio public. Make your letters concise and offer constructive criticism when you can; remembering always that there is something to be said for the other fellow's side.*

Address The Editor, Radio News, *230 Fifth Avenue, New York City.*

"You Can't Get Nothin' for Nothin'"

Editor, Radio News:

The letter in the February issue which is titled "The Navy to the Rescue" is about as funny a contribution as I have had the pleasure of reading in some time—truly, it's a joke of the first water—naval type.

I hold no brief for the chap from South Dakota—or his views—but when anyone suggests that the listener in North Dakota is getting his radio entertainment *for nothing* that's a good place for a raucous laugh.

Getting radio entertainment for nothing? Huh—I suppose that chap in Cuba thinks he is getting the entire value of the contents of Radio News every month for his two bits. Far be it from so—just how long would the owners of Radio News continue to give what they do for a quarter of a dollar per copy *if they carried no advertising? YOU TELL 'EM.* Presumably Cuba thinks that he is paying for all he gets when he gives up a jitney for the Saturday Evening Post—and that he gets nothing for nothing. That nickel for the S. E. P. wouldn't pay the cost of printing and transportation. Who pays the authors?

(*Continued on page* 1292)

A World-Wide Election by Radio News Readers in 1928

SINCE Radio News is edited and published for *you,* the problem of giving you exactly what you want is always foremost in the minds of its editors. They have two ways of finding out—first, to give you what they think you want, and wait to see if you continue to be a reader—and, second, to come out frankly and ask you to say what you want.

This election, therefore, is to learn how many of you want one thing, and how many another; what you want to read more of, and what you want dropped. Whatever most of you vote for, the editors will see that you get more of; they have no reason to impose their personal likes or dislikes in the matter. The editorial selection of articles for Radio News is governed by your preferences, so far as they can be learned; and it is up to you to express your suggestions for improvements in this magazine to suit your taste. We trust that you will consider it your privilege, no matter where you live, no matter how long you have been a reader, to fill in the ballot which follows, and send it to the Editor. It will be carefully checked and counted.

If you do not wish to cut your copy of this magazine, a note or a card indicating your principal preferences and suggestions will be gladly received. If you dislike anything, tell us; if you wish any subject given more attention and lengthier description, feel free to say so. Sign your name or not as you prefer; but if you do not sign and are a woman, please indicate the fact—for Radio News wishes to be equally interesting to all in the household and to carry articles of special interest to our feminine readers, whom we know to be already numerous.

The result of the voting will be announced, as soon as a sufficient number of ballots have been received; and the wishes of the majority will be respected. Departments will be retained only if they meet the demands of a substantial element of our readers; those which are favorites of the greatest number will be improved and enlarged. Vote early—and often, if you wish.

(*Ballot on page* 1275)

Sylvia Miller

Youthful soprano who is featured regularly in the Sunday evening broadcasts of the Capitol Family through WEAF and its chain of stations.

Mitza Stillman

One of America's foremost viola players, who is heard frequently over the Columbia radio chain as a soloist on his instrument.

Adelaide De Loca

A frequently-featured artist in the weekly program of Roxy's Gang from the WJZ network. She has sung many contralto parts.—

How Broadcast Programs

Careful Study and Painstaking Operators "Behind the Scenes"

By G. C.

THE general conception of the method of broadcasting a program, entertained by the average listener, is that a microphone is placed before a performer and somehow or other the music goes out on the air from the transmitting antenna and is received by his set. The intermediate steps through which the electrical energy goes, between the time the artist performs before the microphone and the time the signal reaches the transmitting antenna, are varied and interesting, though not popularly understood.

It is common knowledge, of course, that during these steps the energy is magnified to an enormous extent, but that is not the entire story by any means. Let us consider the various processes which must be gone through between the time it is decided to broadcast a program and that when the transmitting antenna is energized.

Below, the scene of "remote control"—a night club in New York. Follow the pictures around.

ARRANGING THE PICK-UP

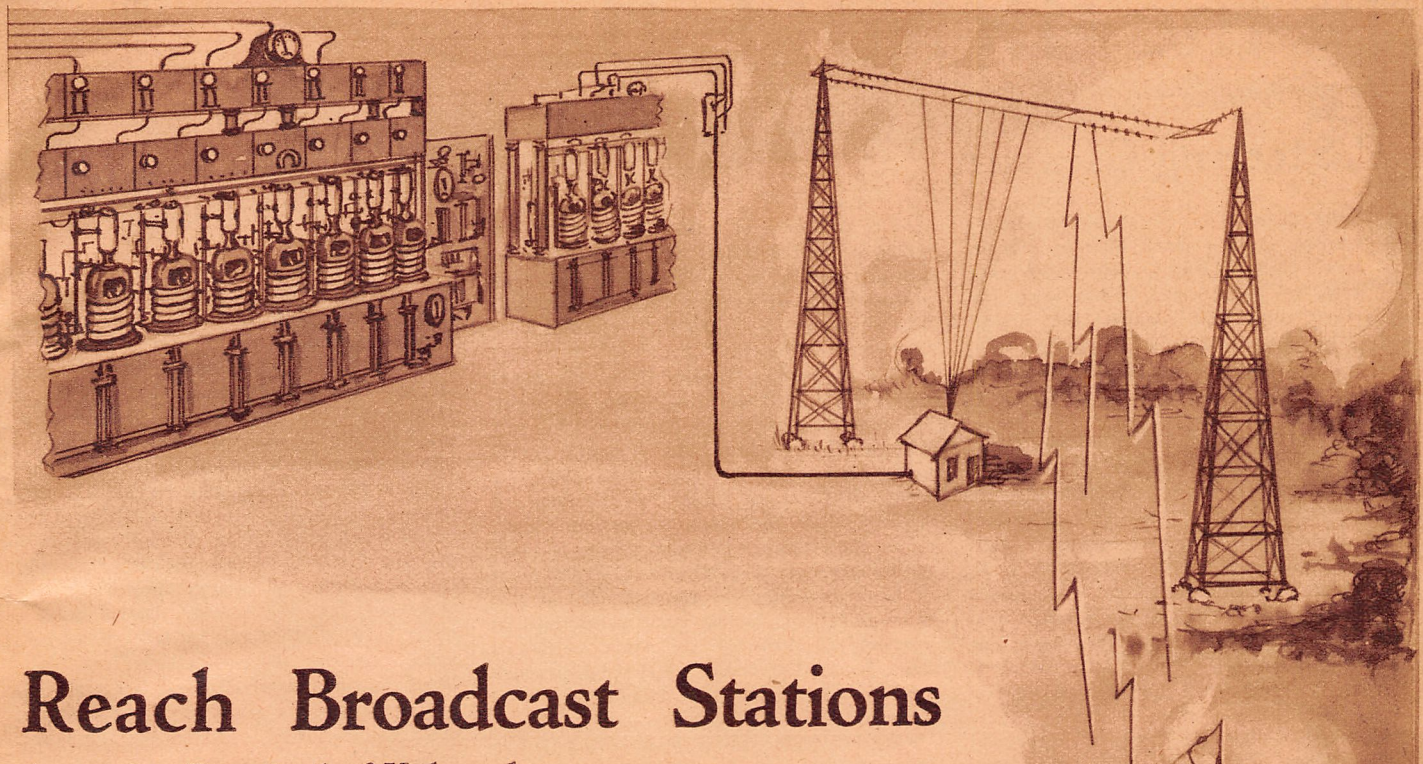
As an example, let us trace the operations necessary for the broadcasting of orchestral music from a night club in New York City over WEAF and its chain of stations, the Red Network. First of all, an engineer must install the microphones (two of which are used in an ordinary orchestral broadcast) in such a way that every instrument in the ensemble will be picked up with the proper volume. This placement is very important; for if the microphones are placed so that the saxophones are too close to them, for instance, then the music from these instruments may drown out that of the violins.

The quality of the music is, of course, affected by the surroundings. In some cases it becomes necessary to "dampen" the hall by hanging draperies about to cut down the echo. In other cases no hangings are required; for a certain amount of echo is needed to give naturalness to the music. In the case of a large orchestra there must be in the music "brilliancy," provided by the string instruments, and the microphones must be so placed that these high tones are not impeded in any way.

When the proper position for the microphones has been found the amplifier and the microphone mixer are placed so that their operator will have an unobstructed view of the orchestra leader.

TESTING THE LINES

Then the telephone lines from the night club to the National Broadcasting Company's building at 711 Fifth Avenue are tested to see that they will carry the entire range of frequencies required in the proposed transmission. This test is not made with music or by ear, because of the deceptive variation of human hearing. Different



Reach Broadcast Stations

Attention Required of Unheard From Studio to Transmitter

B. Rowe

notes are introduced into the lines by an oscillator, giving a range of frequencies covered by an average orchestra's program; these frequencies are measured by a meter. These tests show also whether the lines will carry the necessary frequencies at equal volume; which is an important point for the same reasons as those given above for the proper placing of the microphone.

In the microphone mixing panel the proper proportioning of the frequencies is made for the particular "set-up." The amplifier, which is connected with the mixing panel, is used to "boost" the output of the microphone, so that there is a high ratio between the volume of the music and the noises on the telephone lines. On the output side of this amplifier is a galvanometer, which functions as a volume indicator, and it is at this point that programs can be made or marred.

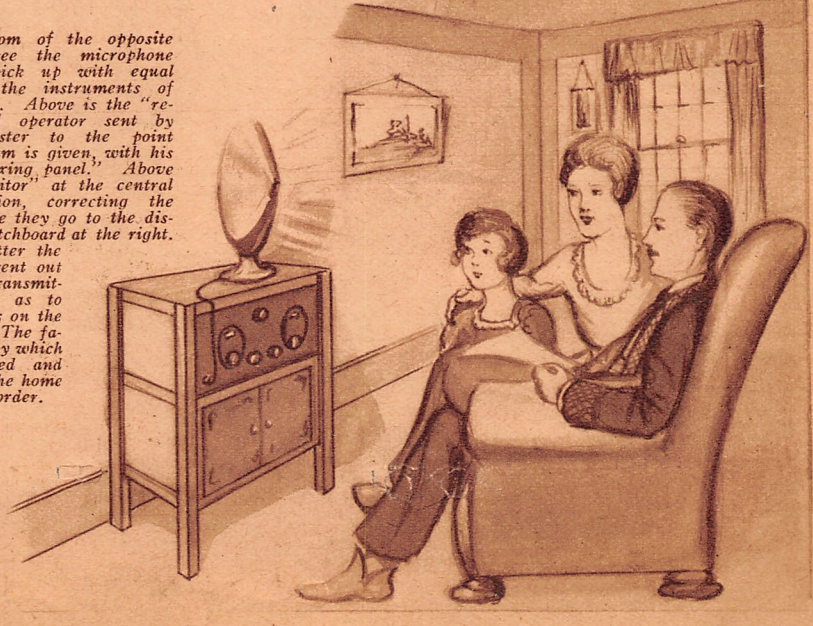
To make this point clear, it is necessary to digress for a moment. It has doubtless been the experience of the reader, when listening to a large orchestra, to have certain passages that are played *fortissimo* ring in his ears. On the other hand, some portions of the same selection were played so softly that it was almost impossible to hear them at all. In other words, there is a ratio between *fortissimo* and *pianissimo* of approximately fifty to one: that is, the loud parts are approximately fifty times louder than the soft parts. (This ratio, of course, varies with every selection played.) When music is broadcast this ratio must be greatly reduced; as the average receiving set has a ratio of selective audio reproduction amounting to only six or eight to one. This means that, if the volume of the music at the place of pick-up were undiminished, it would blast at the loud speaker and be greatly distorted.

CONTROLLING THE VOLUME

It is the function of the volume-indicator meter to show just how the music is going over. The scale of the meter is divided into 100 divisions and, as the music is played, the needle of the meter is continually varying according to the intensity of the music. Now, in order to keep the volume within the desired limits, we will say that the needle must not go above 60 for *fortissimo* passages and below 30 for *pianissimo* parts. The operator must see to it that these limits are never exceeded, and he controls the volume by a rough and fine adjustment.

The control of the volume may be likened to that of an automobile traveling along a road through hilly country. It is desired to maintain a speed of at least 30 miles per hour going up-hill, and not to exceed 60 miles per hour on the down grades. The accelerator will often have to be used on

(*Continued on page* 1260)



At the bottom of the opposite page, we see the microphone placed to pick up with equal fidelity all the instruments of the orchestra. Above is the "remote-control" operator sent by the broadcaster to the point where program is given, with his portable "mixing panel." Above is the "monitor" at the central control station, correcting the signals before they go to the distributing switchboard at the right. From the latter the program is sent out to the local transmitter, as well as to other stations on the same chain. The familiar steps by which it is radiated and received in the home follow in order.

In the BRIGHT Darkness

BY
C. Sterling Gleason

IN the offices of his great motion-picture studios, Harold Dare, hero of a thousand Flicker Films, held conference with his engineers. "What have you unearthed, men, that required this urgent call?" he demanded. "Is it possible that Dandy Diavolo, my unscrupulous arch-enemy, proposes to perpetrate another perfidious plot?"

The great Scott, chief of the stern-faced, silent group, addressed him.

"Yes, Mr. Dare, you have pierced directly to the heart of the matter. Our detectives have unearthed conclusive evidence that Dandy Diavolo has purchased machine guns, rifles, and ammunition, which he proposes to smuggle to the rebels in the South American republic of Habanera. Knowing how anxious you are always to further the ends of justice, I felt it my duty to apprise you of our findings."

"You have done right, Scott," approved Harold Dare. "We must foil this dastardly attempt to further strife and bloodshed. Diavolo's present plot is perfectly on a par with his past performance. Little cares he for the letter of the law, the spirit of the Monroe Doctrine, the Constitution, the Eighteenth Amendment, or any of those glorious principles for which our forefathers fought, bled and died—"

"Exactly," agreed Scott. We await only your word to go forward with plans for the foiling of Diavolo's plot. We realize that it is your first duty to your public to maintain your schedule of pictures; but we assure you that while you are giving heart and soul to your work, we will be doing our utmost to devise a plan that will foil Diavolo very thoroughly."

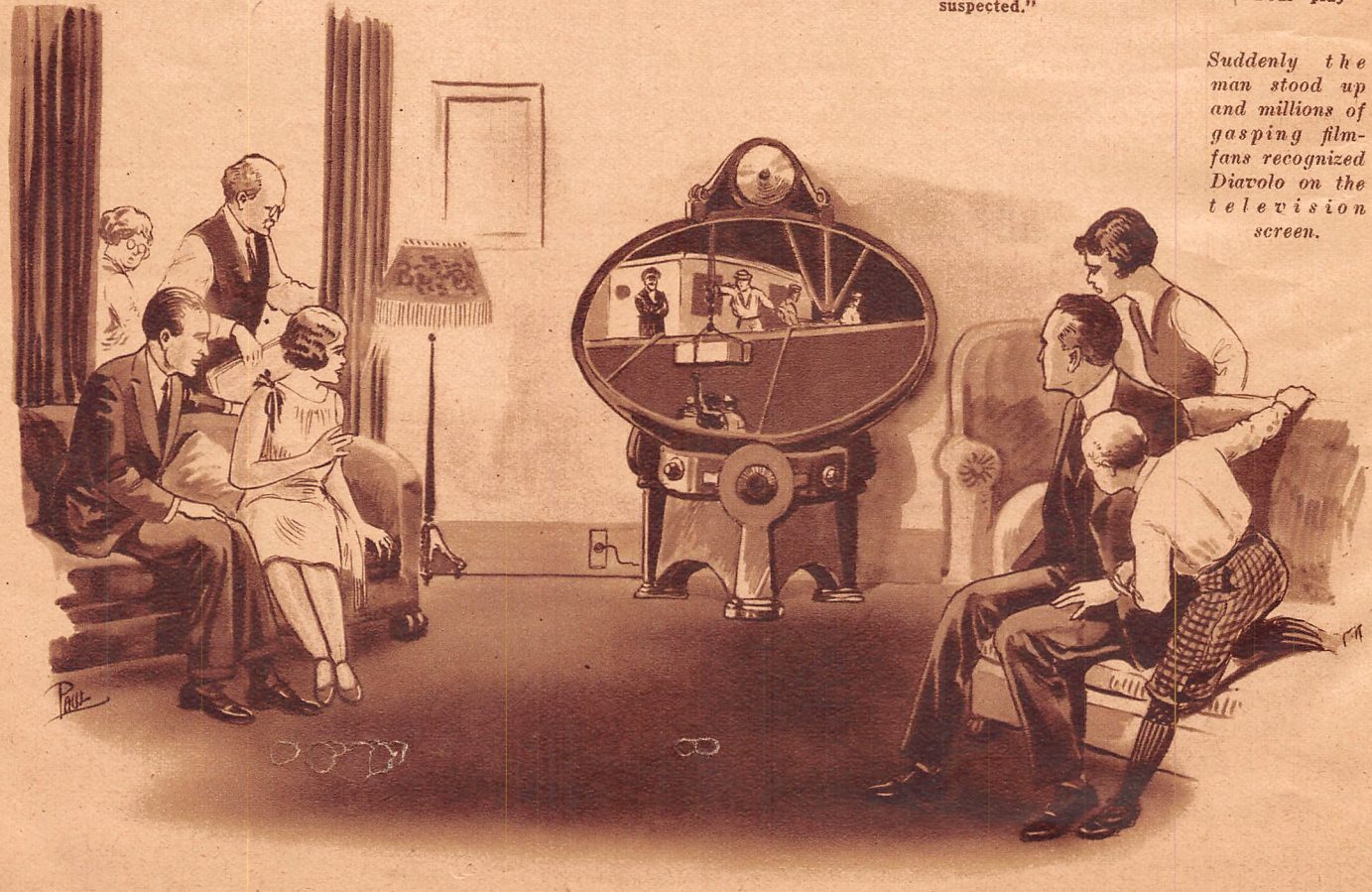
"Scott," spoke Harold Dare, his heart touched by such devotion, "you are right. My first duty is to my Art. Go! do your utmost. I am behind you. Prepare everything. Spare no expense. Assemble your men and await me tonight at the dock. I shall conduct the work in person. And, again, the attempt to smuggle the guns must be foiled; but, also, Dandy Diavolo must be made to suffer the consequences of this outrage. Some means must be devised to prevent his throwing the arms overboard when he is discovered. We must procure positive proof that will fasten the crime upon him."

"Mr. Dare," replied Scott, "the entire Dare technical staff will weave a web to entangle this arch-fiend, whose fell design it is to flout the forces of law and order. We shall devise such a means."

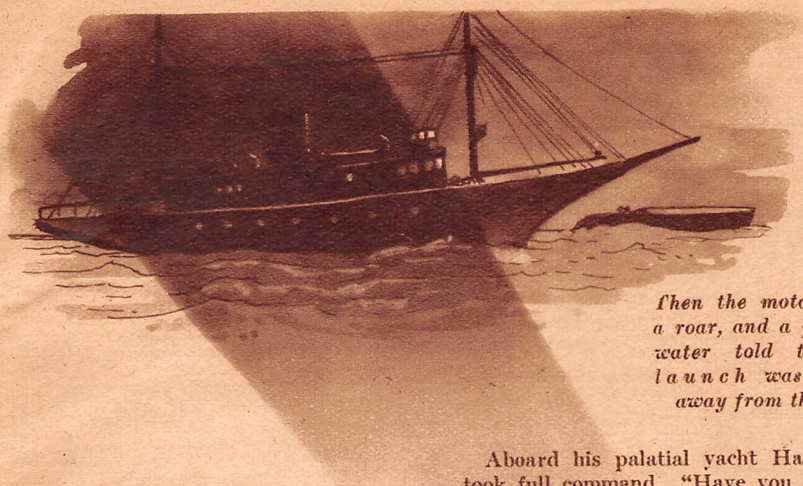
Standing on his platform, behind the battery of cranking camera-men, Director Topping, of the Flicker Films, raised his megaphone. "Cut!" he bellowed. "That will be all for today." The great Kliegs died. From every corner of the huge set, extras, electricians, cameramen, and yes-men, poured forth. Stars came hurrying past, nodding to the directors, and disappearing through their private exits into the inner court, where a dozen incredibly long and splendid automobiles waited to whisk them away. Among them, beautiful Rose Blush, charming ingenue of the Flicker Films, came tripping through the door and stepped into her glistening new 1930-model Hexpenso-Wheeza limousine. "Home, Jimmy," she murmured. She sank back on the goofer-feathered cushions and closed her eyes, while the great car rolled smoothly down Hollywood Boulevard and toward the lights which sparkled on the hills overlooking the city. A sudden swerve of the car threw her to a sitting position. She screamed. On the running board stood a man, holding a pistol to her chauffeur's head. The car stopped with a jerk. The doors opened; arms clutched her and carried her toward a great black sedan at the edge of the road. Again she screamed. Something wet and sweet-smelling was thrust under her nose. As she sank into unconsciousness, she glimpsed an incredibly evil, sneering face, and heard the hard ring of a cruel, mocking laugh.

In his luxurious town car, Harold Dare was being whirled swiftly toward the wharf. A signal flashed red, a semaphore rose, and an endless stream of traffic poured before them. Newsboys dodged between the halted cars. Dare rapped on the window; a paper was handed to him. A headline met his eye:

"FAMOUS FILM STAR DISAPPEARS
Rose Blush, Flicker Film favorite, missing. Police comb city. Chauffeur held at point of gun as star is chloroformed by bandits in mysterious black car. Foul play suspected."



Suddenly the man stood up and millions of gasping film-fans recognized Diavolo on the television screen.



Then the motor rose to a roar, and a purling of water told that the launch was speeding away from the yacht.

What incredible catastrophe was this? Only a few hours ago, he had played the hero's part opposite beautiful Rose Blush, in the new Dare superspecial. Now she was helpless in the clutches of some heartless monster, whose evil intentions were only too evident. He must rush to her rescue at once! Yet, his duty lay before him: he must insure the success of his men against that supervillain, Dandy Diavolo, whose perfidious plot threatened the very foundations of international relations. What course should he choose? His keen judgment came to his rescue. If he abandoned his men, their venture would assuredly fail; he himself could do nothing toward finding the missing maiden until he assembled his experts and wove that thorough chain of analysis, which was the secret of his countless previous triumphs over his unscrupulous arch-enemy. In a few short hours, the traitorous gun-runner would be captured, then he could concentrate the efforts of his entire organization upon the search for his radiant Rose. He must take one step at a time.

Aboard his palatial yacht Harold Dare took full command. "Have you everything ready, Scott?" he asked.

"Yes, Mr. Dare," replied Scott, leading him forward on the deck, where a group of grim-faced men sat, silently adjusting instruments by the light of tiny hooded bulbs. In the dim light Dare distinguished various pieces of equipment. Nearby stood a huge concave reflector like an enormous kettledrum. "What is this?" asked Dare.

"This is a paraboloid sound reflector," replied Scott. "It works on the reverse of the principle of the searchlight: that is, it picks up a 'beam' of sound (from one direction only), reflects and concentrates it upon a microphone held by those arms in front of the reflector. This tremendously sensitive sound-detector is now pointed toward Diavolo's yacht. No doubt he also has some such device, therefore absolute silence on our part is necessary."

"And are you prepared to board Diavolo's yacht?" asked Dare.

"Yes, Mr. Dare," replied Scott. "Our yacht has full steam up, and we are prepared to pursue Diavolo, also, in speed boats, hydroplanes, and submarines. The Coast Guard forces have joined us; their chief and a Federal officer wait alongside in a fast launch."

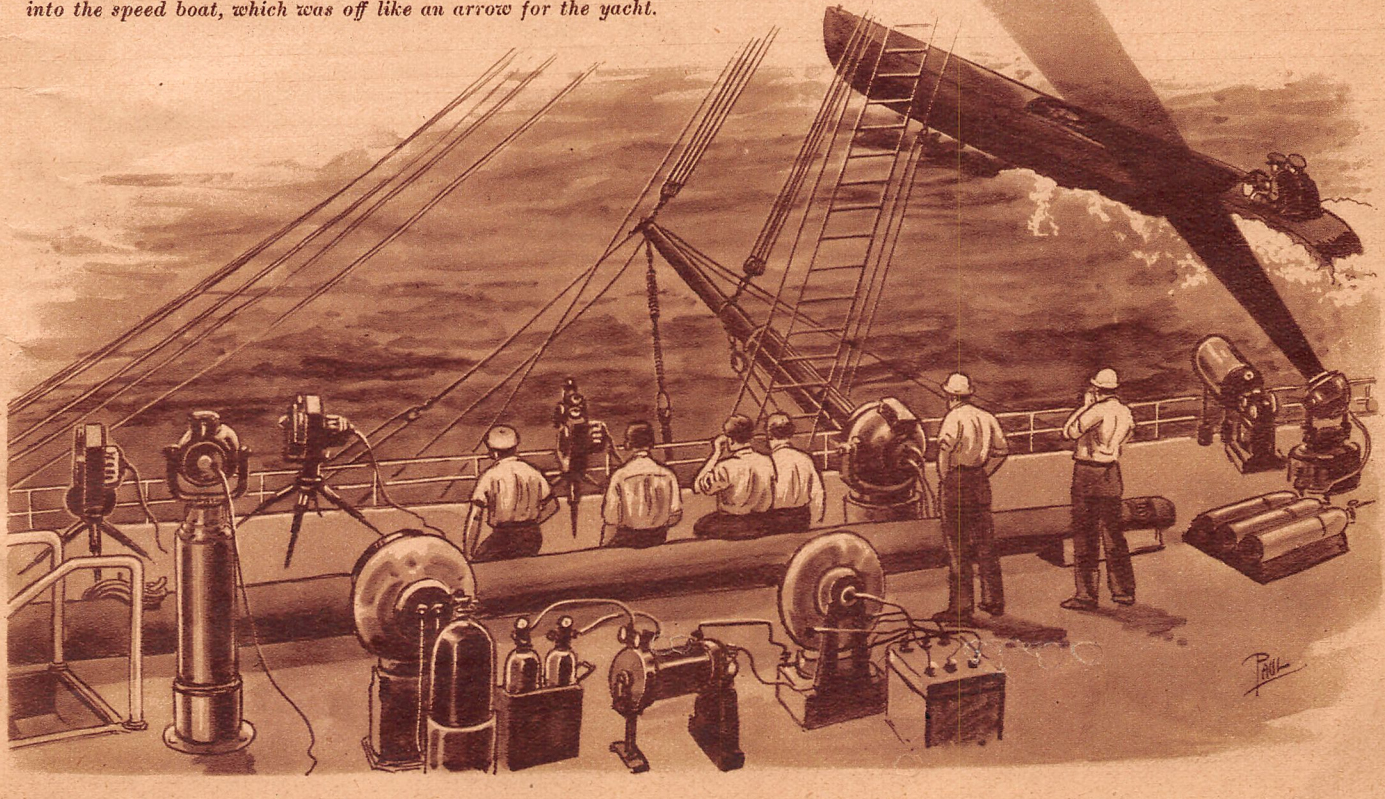
"Yet I do not see," Dare pursued, "how, without being detected, we are to procure evidence that Diavolo actually took aboard the guns."

"There is the answer to that question," replied Scott, pointing to what appeared to be a bank of huge searchlights, arranged in strong frames along the upper deck, and pointed toward Diavolo's yacht. A bank of motor-driven motion-picture cameras also stood trained on the yacht. "What does this mean?" demanded Dare. "Do you propose to photograph Diavolo and his crew in the light of those search lights? I cannot endorse such a plan. The very instant that that powerful beam is turned upon him, he will abandon his plan and hastily dispose of the guns he has taken aboard. We shall have no evidence of value."

"That is exactly the chain of reasoning Diavolo undoubtedly followed," said Scott. "Yet he does not know that *what to his eyes is darkness, is actually, to the all-seeing eye of the camera, the brightness of noonday.* He will be searched out in the blackest darkness as surely as in the brightest daylight. Those searchlights above you are tremendously powerful—so powerful that the human eye cannot detect them. Our eyes respond only to that narrow band of light rays between the darkest red and the deepest violet; but these great searchlights give light waves longer than the longest visible red. They emit rays of infra-red light, which is invisible to the human eye. These cameras are equipped with color filters, and the film is sensitized to infra-red light, so that when it is developed, everything will appear exactly as it would in broad daylight. Yet, this is not all. The infra-red light that affects the sensitized photographic plate, affects the photoelectric cell as well. Diavolo's movements will be picked up by television ap-

(*Continued on page* 1258)

The motor-driven cameras whirred; with a cracking sound the huge infra-red-ray generators warmed to their task. Harold Dare jumped into the speed boat, which was off like an arrow for the yacht.



Broadcastatics

HOW SHOCKING!

INDIGNANT NEIGHBOR: "Talk about your rabid radio fans, why that man Brown can't think of anything else. A few days ago, when his wife remarked that the baby looked a little 'run-down,' he went and hooked the poor kid up to the battery charger!"—*H. N. Webster.*

PUT A CONDENSER ACROSS HER

RADIO EXPERT: "Perhaps the three greatest sources of interference are X-ray machines, circuit-breakers and electric railroads."

THE OTHER FELLOW: "By, the way, you haven't met my wife, have you?"

CALL FOR MR. CASEY

FAN: "I got a new radio set, Jim."

NEIGHBOR: "Is that so? What kind is it?"

FAN: "I don't know, but I call it "Football Radio."

NEIGHBOR: "Why is that?"

FAN: "There's a lot of interference in it."—*Stanley Rodnite.*

THE 100 PER CENT FAN

BRIDESMAID: "What? The groom can't show up? What was wrong?"

GROOMSMAN: "Oh, he managed to tune in Melbourne just before train time."

NO ALIBI LEFT

FIRST RADIO FAN: "Really, you know, you miss a lot by not being married."

SECOND RADIO FAN: "Yes; when I fall asleep at my desk next day I can't blame it on the baby."

SIMILAR CONTENTS

FILBERT: "I really can't figure out what's wrong with my radio set. Maybe I need a new vacuum tube."

HICKORY: "Just use your head, man; use your head!"—*Mrs. Bill Howard.*

THIS page is devoted to humor of purely radio interest; and our readers are invited to contribute pointed and snappy jokes—no long-winded compositions—or an original nature. For each one of this nature accepted and printed, $1.00 will be paid. Each must deal with radio in some of its phases. Actual humorous occurrences, preferably in broadcasting, will be preferred. Address Broadcastatics, care RADIO NEWS, 230 Fifth Avenue, New York City.

RETALIATION

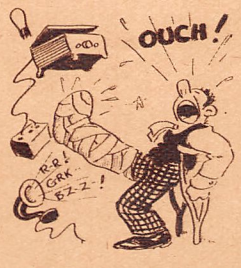
MOTHER: "What is your father sputtering about?"

DAUGHTER: "He can't get the radio to stop sputtering."—*Gleason Pease.*

GRIN AND BEAR IT

VISITOR: "Pretty nice, eh Bill, having a radio to entertain you when you've got a broken leg?"

PATIENT: "Well, I certainly can't kick."



CALL DIOGENES

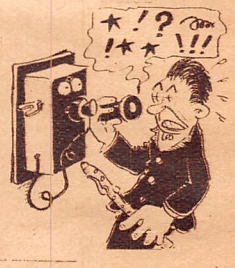
MISSOURIAN: "I don't know whether to believe Bill's DX reports or not."

HAWK-EYE: "Oh, Bill's honest. He even writes to the local stations, for verification of selections heard, before he puts them down in his log book!"

CENSURE NEEDS CENSORING

STATION FLUNKEY: "Telephone! Somebody's calling the piccolo player!"

CORNETIST (*sotto voce*): "What are they calling him this time?"



A TOWER OF TRUTH (?)

The Woolworth tower looks big and bold,
Its stories are many and high;
But more and taller the stories told
By the one-tube DX guy.
—*Arthur Wolfendale (England)*

DEAD FROM THE NECK UP

BINKS: "Not so very bright, is he?"

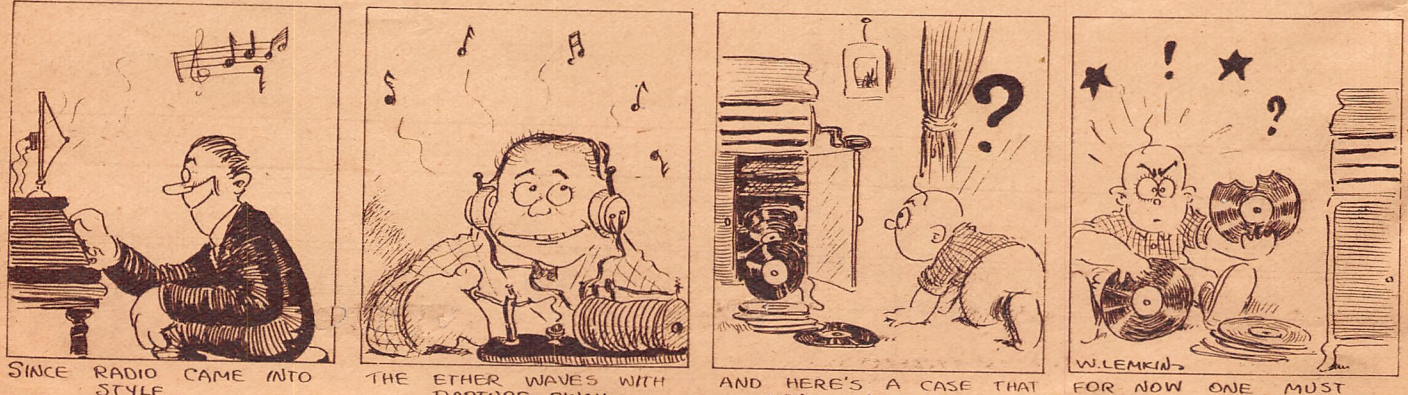
JINKS: "Naw! he thinks a short circuit is a hook-up used to tune in the short-wave stations."—*Wm. G. Mortimer.*

WHAT HE NEEDED WAS EXERCISE

FIRST PIANO MOVER: "You ain't lookin' well, Bill."

SECOND PIANO MOVER: "Naw. Ever since my set went flooie last week I been missin' out on the Daily Dozen hour."

RADIO RHYMES ..... No. 7


SINCE RADIO CAME INTO STYLE
WITH TUNES THAT CHEER AND BRING A SMILE,
THE ETHER WAVES WITH RAPTURE SWAY--
"THERE'S MUSIC IN THE AIR!" WE SAY--
AND HERE'S A CASE THAT YOU CAN TELL IS VERY CLOSELY PARALLEL--
W.LEMKIN
FOR NOW ONE MUST CONFESS THAT THERE IS ALSO "MUSIC IN THE HEIR!"

Listener Psychology and Radio Reception

How Your Own Frame of Mind at Any Time Affects Your Enjoyment of a Program; A Discussion of a Little-Known Subject

By Charles Magee Adams

DID you ever invite a group of friends in to hear your receiver perform? If you did, you have no difficulty about recalling what happened.

With the air of a proud parent describing the prowess of a first baby, you told them how, the night before, it had brought in stations 2000 miles away—"just like local." Then you twirled the dials, only to make the dismaying discovery that you were doing exceedingly well to get as much as a whisper from stations 500 miles away. At this embarrassing juncture one of your friends suggested, with suspicious readiness, that perhaps atmospheric conditions were not so favorable as on the night before, a diagnosis to which you agreed immediately. But after they left, you worked till the wee hours, checking tubes, batteries, connections, everything that might be wrong with the pesky receiver.

Maybe you did find something wrong, and maybe atmospheric conditions weren't all they might have been. But, be that as it may, the odds are more than even that the chief trouble was psychological.

You have probably heard the man who reaches the ninth hole, six down, offer psychology as an alibi, all too often; or listened to salesmen discourse on psychology as a factor in persuading prospects to sign on the dotted line. But, as something affecting radio reception, it has never occurred to you. Nevertheless psychology does play a part in reception nearly as important as the state of your receiver or atmospheric conditions, which usually get all the blame and credit.

Radio has two elements, the technical—transmitter, receiver, static, man-made interference, etc.; and the human—the operator, the listener; and whenever you introduce the human element you inevitably, if as a rule unconsciously, must introduce psychology.

"DIAL FRIGHT?"

That night when you invited your friends in to hear your receiver perform is a typical example. Your set was probably in apple-pie order, and atmospheric conditions excellent. But it failed to do what it had done the night before, simply because you were suffering from a case of "buck fever," or stage fright. You would not have admitted it; perhaps were not even aware of it. But just the same, knowing that your friends were there waiting to see what your set would do, you were a bit excited, nervous; and, as a result, lost that delicate touch, that little margin of skill with the dials indispensable for the best DX work.

In other words, you found yourself in much the same situation as a young pianist who can perform superbly alone, but who becomes merely mechanical when playing before an audience; though, if your friends had not been there, you could probably have done just as well as the night before.

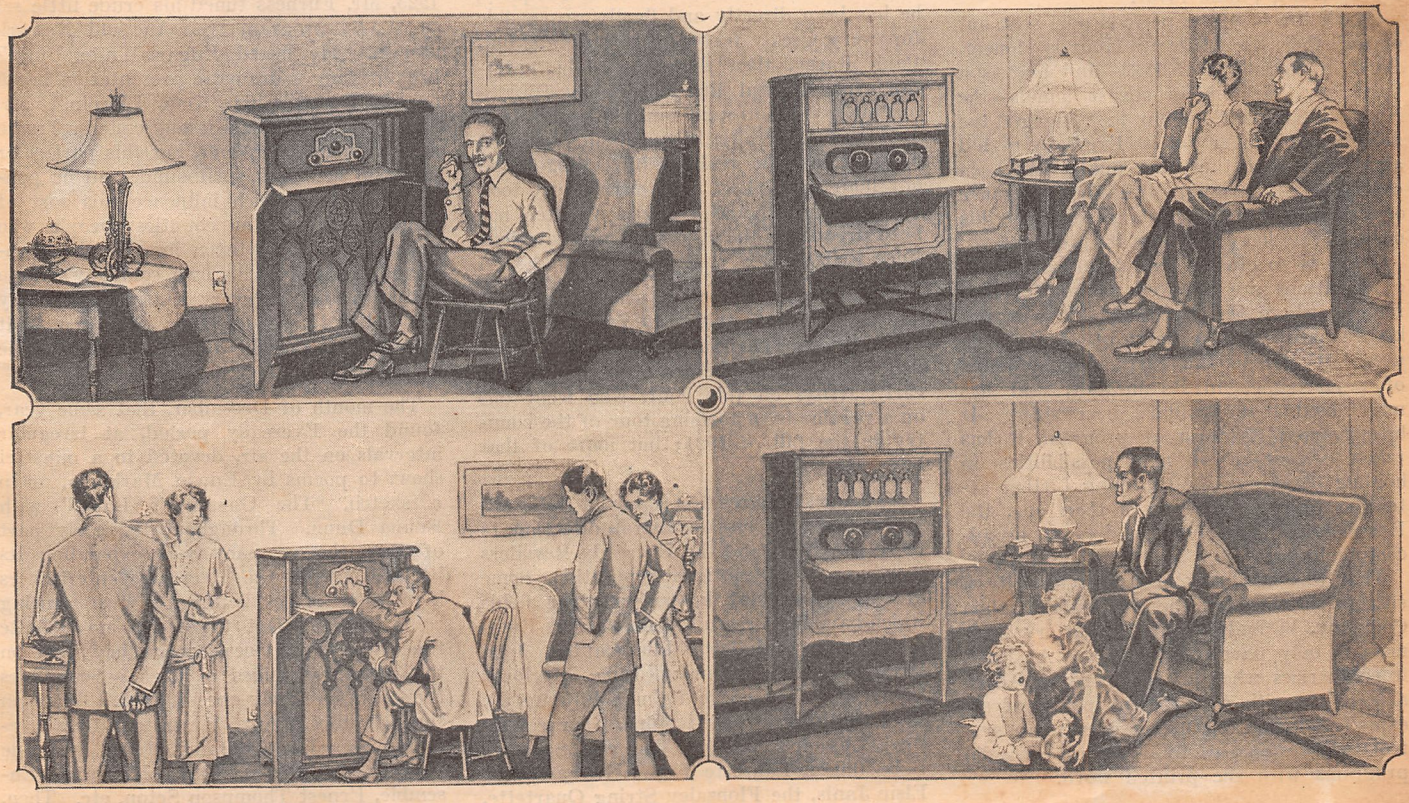
I hope you begin to see by this time that psychology plays an important part in radio reception; for it does, even though as a rule this is not recognized.

"IS THERE COTTON IN YOUR EARS?"

As another example, you have no doubt tuned in some evening and, after listening a few moments, remarked that "the set doesn't seem to be as loud as it should." A check-up may show everything about the receiver as it should be. Yet the lack of volume persists; and you conclude that the station to which you are listening must be using less power than normal, or that atmospheric conditions are bad. Either of these explanations may be correct. But the chances are that your psychological response is simply below normal.

If you are tired and distracted after a trying day, or if you have been subjected to excessive noise a short time before, say, riding through the evening traffic, your hearing will be dulled. As a result, volume

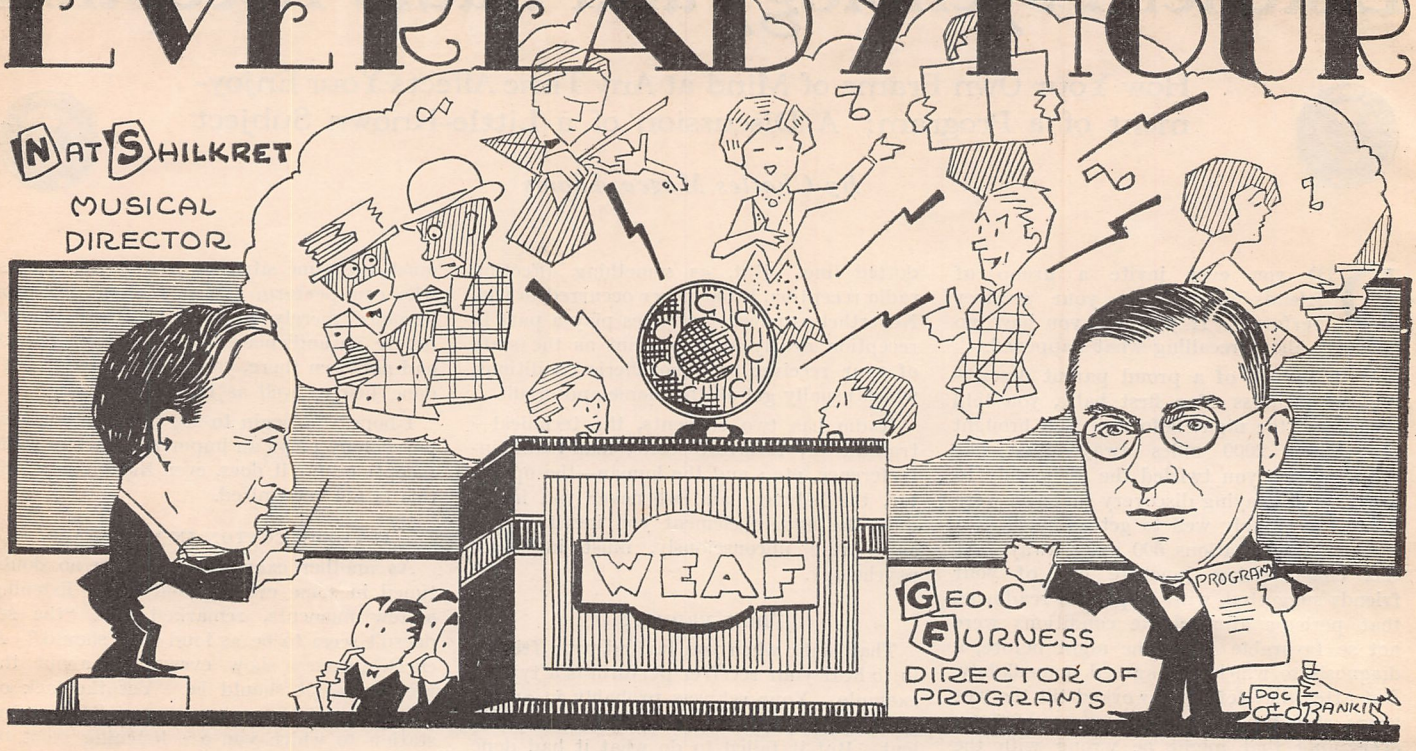
(*Continued on page* 1265)



When you're alone with your set and feeling at ease, you can make it work wonders; but when company is present you get "dial fright," and everything seems thoroughly hopeless.

When the house is quiet and you can sit back comfortably, you are able to really appreciate a talk or a musical rendition; but, if the local atmosphere is irritating, everything will sound "sour."

EVEREADY HOUR



By Julia V. Shawell

RADIO entertainers have come and gone. Waves of popularity have raised artists and features to celebrity, and receded again. There have been many ups and downs in an industry yet so young. Whole organized periods have disappeared and new modes of entertainment have followed them. But the oldest commercial broadcaster on the air is still holding its place, and is sold more than ever on the value of radio as a medium of exploiting public favor.

Of all the toll-time periods now sent out on the ether, the Eveready Hour is pioneer. Back in December of 1923—and that is a long way back in broadcast annals—the National Carbon Company first engaged the facilities of WEAF for its Eveready period and, since that time, the public has been confident in turning, with the assurance of a worthy entertainment, to whatever this organization has offered on its program.

There is no place where American broadcast stations are received, no matter how remote, where the Eveready Hour is not known as one of the finest of all air features. It revealed an early high standard of performance in its infancy, and has maintained that standard ever since. It has changed its form of program, it has taken advantage of new possibilities in holding its hearers and gaining further attention but, in more ways than one, the Evereadyites have been leaders of broadcasting ideas.

That this hour has been commercially a successful one for the National Carbon Company, in building up its battery business, is only part of the story. At least, it emphasizes what one company has been able to do with a consistent policy of air exploitation, backed by an even more systematic campaign of following up its radio programs with the printed word.

INTRODUCING A NEW IDEA

The "continuity" idea was first tried out by Eveready, and some of the finest programs ever broadcast may be credited to this hour. In every new season its executives have carefully worked out plans for entertainment. They have sought novelty, promoted new ideas and at the same time carefully avoided any repetition that would reach the boresome stage.

Since the inaugural program on December 4, 1923, G. C. Furness has been Eveready's air pilot. As manager of the radio division of the National Carbon Company, he has been directly and finally responsible for every weekly feature that has gone out. Paul Stacey, then director of the entertainment, evolved the plan for writing a continuity plot around musical broadcasts; Just how generally this method has been adapted may be realized by tuning in on any hour now. Last year, Mr. Stacey took up other work and Douglas Coulter has been arranging the Eveready presentations since that time.

It was also Eveready which first sent out a radio entertainer to make personal appearances. Their ambassador was Wendell Hall, one of the most popular of the early artists on this hour, who went out on a regular barnstorming tour of the country in the fall of 1924; but more of that later.

Nathaniel Shilkret first gained a radio following through his orchestral direction in these programs and the Eveready Revellers now have an international reputation. Some of the names best known in other fields which have been recruited for various Eveready hours include: Eddie Cantor, John Drew, Ignaz Friedman, Julia Marlowe, Lionel Atwill, George Palmer Putnam, D. W. Griffith, Beatrice Herford, George Gershwin, Francis Wilson, Van and Schenck, Belle Baker, Laurette Taylor, Richard Dix, Elsie Janis, the Flonzaley String Quartette, Ernest Hutcheson, Weber and Fields, "Bugs" Baer, Pablo Casales and a host of others.

From little incidents in the busy lives of individuals, important events develop; and the Eveready Hour, while it was bound to materialize in an organization with the foresight and wide scope to be found in that company, was hastened by a Sunday afternoon radio program sent out from Newark, N. J.

RADIO SELLS ITSELF

On a hot-summer Sunday afternoon in 1923, Mr. Furness tuned his crude little set to WJZ's program from the old Newark station. He heard Edgar White Burrill broadcasting a dramatic presentation based on Ida Tarbell's "He Knew Lincoln." Mr. Furness was what his family called a "radio nut" even in those days, but this particular program held him spellbound, and he pondered on how much influence this sort of thing could have on countless people who might be made to listen in. He then conceived the idea of his own company's radio activities and, on every Lincoln's Birthday since, the Eveready Hour has been built around Mr. Burrill's offering of that same selection.

The month of December, that same year, found the Eveready period, at irregular intervals on the air, devoted to a minstrel show, to poems by Edwin Markham, or to a sketch, "The Governor's Lady," with Emma Dunn. Throughout the early part of 1924 the company was expanding its business, while the Eveready entertainers kept their places before the ever-growing radio public. But there was no definite time for them. Occasionally they went on the air three times a week. Sometimes they appeared only once a week. But even through this irregular stretch, they presented imposing programs offered by Cissie Loftus, May Irwin, Yap's Hawaiian Ensemble, Ernest Thompson Seton, etc. Then, in September of that year, arrangements were made to engage an hour a week on

(*Continued on page* 1273)

Around the Musical World by Radio

Musical Appreciation Taught in a Series of Attractive Programs Based on National Melodies

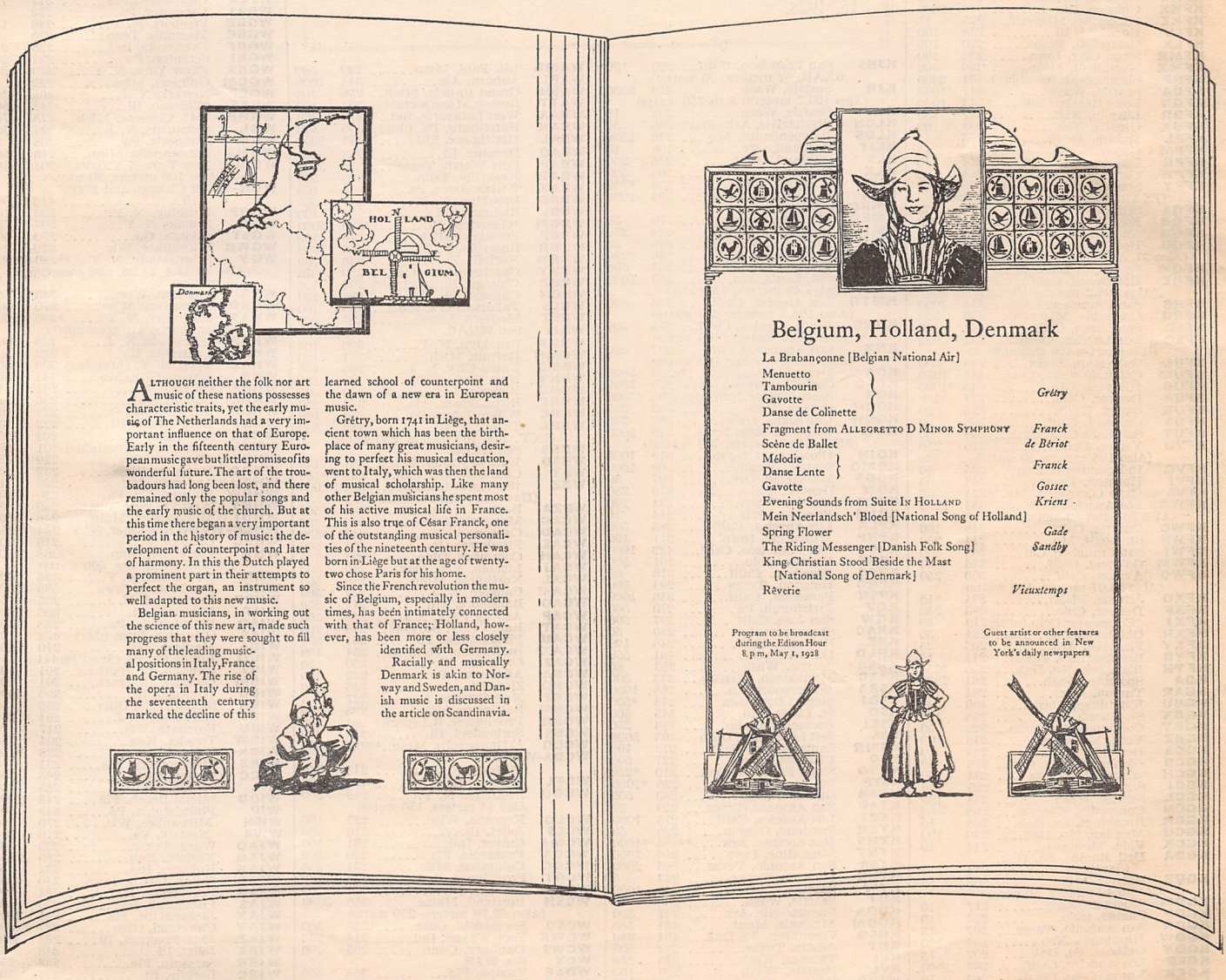
ONE of the greatest gifts of radio, especially with the wonderful fidelity of reproduction obtained from modern receivers, to the great audience of music lovers is an increased appreciation of the finest interpretations which trained artists can give to the masterpieces of great composers. This applies not merely to the classical music which requires long training to value at its full worth, and which will always be limited in its appeal, but also to those melodies which speak of the soul of a people. As there are many languages now stirring the ether from radio stations in every land, so there is a distinct element of nationality in music; but this universal language has the inestimable advantage of being intelligible to all.

The national music of a people stirs the hearts of those among whom it originates, as does "one's mother tongue in a far land"; but it nevertheless has a charm of its own to those who lend a listening ear to the interpretation of a nation's emotions. At the foundation of national music, however complex its development, lie the simple, pleasing melodies which are the spontaneous production of a people.

To combine pleasure with instruction in the myriad languages of music has been the fundamental idea of the series of weekly programs which have been broadcast during the past year from the RADIO NEWS station, WRNY, through the co-operation of the New York Edison Company; and thousands of appreciative letters from our readers show how this remarkable feature has become a looked-for event in their weekly radio calendar. To enhance its value to the radio audience, a handsome book dealing with the series of current programs of the Edison Hour has been prepared by Josef Bonime, director of the well-known Edison Ensemble; and in interesting form it describes the characteristics of the music of some forty peoples, which are topically arranged in the programs of the coming season. To this little volume has been given the appropriate title of *The Music Map of the World;* and it will be a welcome addition to the bookshelf of every lover of radio music.

All trained lovers of music can readily distinguish the national characteristics in the music of different countries; for through years of listening they have learned to associate certain moods of music with certain races. There is something in the music of a country that labels it as peculiar to its people, and it is with these characteristics that *The Music Map of the World* deals.

(*Continued on page* 1291)


HOL LAND
BEL GIUM
Denmark
ALTHOUGH neither the folk nor art music of these nations possesses characteristic traits, yet the early music of The Netherlands had a very important influence on that of Europe. Early in the fifteenth century European music gave but little promise of its wonderful future. The art of the troubadours had long been lost, and there remained only the popular songs and the early music of the church. But at this time there began a very important period in the history of music: the development of counterpoint and later of harmony. In this the Dutch played a prominent part in their attempts to perfect the organ, an instrument so well adapted to this new music.
Belgian musicians, in working out the science of this new art, made such progress that they were sought to fill many of the leading musical positions in Italy, France and Germany. The rise of the opera in Italy during the seventeenth century marked the decline of this learned school of counterpoint and the dawn of a new era in European music.
Grétry, born 1741 in Liège, that ancient town which has been the birthplace of many great musicians, desiring to perfect his musical education, went to Italy, which was then the land of musical scholarship. Like many other Belgian musicians he spent most of his active musical life in France. This is also true of César Franck, one of the outstanding musical personalities of the nineteenth century. He was born in Liège but at the age of twenty-two chose Paris for his home.
Since the French revolution the music of Belgium, especially in modern times, has been intimately connected with that of France; Holland, however, has been more or less closely identified with Germany.
Racially and musically Denmark is akin to Norway and Sweden, and Danish music is discussed in the article on Scandinavia.
Belgium, Holland, Denmark
La Brabançonne [Belgian National Air]
Menuetto
Tambourin
Gavotte
Danse de Colinette — Grétry
Fragment from ALLEGRETTO D MINOR SYMPHONY — Franck
Scène de Ballet — de Bériot
Mélodie
Danse Lente — Franck
Gavotte — Gossec
Evening Sounds from Suite IN HOLLAND — Kriens
Mein Neerlandsch' Bloed [National Song of Holland]
Spring Flower — Gade
The Riding Messenger [Danish Folk Song] — Sandby
King Christian Stood Beside the Mast [National Song of Denmark]
Rêverie — Vieuxtemps
Program to be broadcast during the Edison Hour 8 p.m, May 1, 1928
Guest artist or other features to be announced in New York's daily newspapers

A reproduction of typical pages from "The Music Map of the World," which contains the itinerary of this radio cruise to forty or more foreign countries and their musical shrines.

List of Broadcast Stations in the United States

Radio Call Letter	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
KDKA	East Pittsburgh, Pa.	**316	50000
	(Also 62.5, 42.95, and 27 meters and other short-wave transmissions on varying power.)		
KDLR	Devils Lake, N. D.	231	15
KDYL	Salt Lake City, Utah	234	500
KEJK	Los Angeles, Cal.	252	250
	(6XAN, 105.9 meters, 250 watts)		
KELW	Burbank, Calif.	229	500
KEX	Portland, Ore.	278	2500
KFAB	Lincoln, Neb.	319	5000
KFAD	Phoenix, Ariz.	273	500
KFAU	Boise, Idaho	286	*2000
KFBB	Havre, Mont.	275	50
KFBC	San Diego, Calif.	248	100
	(Also 65.18 meters)		
KFBI	(airplane) Calif.	204	50
KFBK	Sacramento, Calif.	275	100
KFBL	Everett, Wash.	224	50
KFBU	Laramie, Wyo.	484	500
KFCB	Phoenix, Ariz.	*244	125
KFCR	Santa Barbara, Calif.	211	100
KFDM	Beaumont, Texas	484	500
KFDX	Shreveport, La.	236	250
KFDY	Brookings, S. D.	545	500
KFDZ	Minneapolis, Minn.	216	10
KFEC	Portland, Ore. (day)	214	50
KFEL	Denver, Colo.	227	250
KFEQ	St. Joseph, Mo.	231	*1000
KFEY	Kellogg, Idaho	232	10
KFGQ	Boone, Iowa	210	10
KFH	Wichita, Kan.	246	500
KFHA	Gunnison, Colo.	250	50
KFHL	Oskaloosa, Iowa	213	10
KFI	Los Angeles, Calif.	468	5000
KFIF	Portland, Ore.	229	50
KFIO	Spokane, Wash.	246	100
KFIU	Juneau, Alaska	225	10
KFIZ	Fond du Lac, Wis.	**268	100
KFJB	Marshalltown, Iowa	248	*100
KFJF	Oklahoma City, Okla.	273	*750
KFJI	Astoria, Ore.	250	15
KFJM	Grand Forks, N. D.	333	100
KFJR	Portland, Ore.	240	500
KFJY	Fort Dodge, Iowa	232	100
KFJZ	Fort Worth, Texas	250	50
KFKA	Greeley, Colo.	250	500
KFKB	Milford, Kansas	242	*1500
KFKU	Lawrence, Kansas	254	500
KFKX	Chicago, Ill.	526	2500
KFKZ	Kirksville, Missouri	225	15
KFLV	Rockford, Ill.	268	100
KFLX	Galveston, Texas	270	100
KFMR	Sioux City, Iowa	232	100
KFMX	Northfield, Minn.	236	500
KFNF	Shenandoah, Iowa (day)	461	2000
KFOA	Seattle, Wash.	447	1000
KFON	Long Beach, Calif.	242	1000
KFOR	Lincoln, Neb.	217	100
KFOX	Omaha, Neb.	258	100
KFPL	Dublin, Texas	275	15
KFPM	Greenville, Texas	231	15
KFPR	Los Angeles, Calif.	232	250
KFPW	Carterville, Mo.	263	50
KFPY	Spokane, Wash.	246	250
	(7XAB, 105.9 meters, 100 watts)		
KFQA	St. Louis, Mo.	234	50
KFQB	Fort Worth, Texas	333	1000
KFQD	Anchorage, Alaska	345	100
KFQU	Holy City, Calif.	208	100
	(Also 31, 53, 63, 106 meters, 50 watts)		
KFQW	Seattle, Wash.	217	100
KFQZ	Hollywood, Calif.	232	250
	(Also 108.2 meters, 50 watts)		
KFRC	San Francisco, Calif.	454	1000
KFRU	Columbia, Missouri	250	500
KFSD	San Diego, Calif.	441	500
KFSG	Los Angeles, Calif.	252	500
	(Has short-wave transmitter)		
KFUL	Galveston, Texas	258	500
KFUM	Colorado Spgs., Colo.	484	1000
KFUO	†Clayton, Mo.	545	*1000
KFUP	Denver, Colo.	227	100
KFUR	Ogden, Utah	225	50
KFUS	Oakland, Calif.	208	50
KFUT	Salt Lake City, Utah	250	50
KFVD	Venice, Calif.	216	250
	(Also 105 meters, 50 watts)		
KFVG	Independence, Kan.	225	50
KFVI	Houston, Texas	238	50
KFVS	Cape Girardeau, Mo.	**224	50
KFWB	Los Angeles, Calif.	353	1000
	(Also 105 and 40 meters, 50 watts)		
KFWC	Ontario, Calif.	248	100
KFWF	St. Louis, Mo.	214	250
KFWI	San Francisco, Cal.	268	500
KFWM	Oakland, Calif.	236	*500
KFWO	Avalon, Calif.	300	250
	(Also 53.07 meters, 100 watts)		
KFXD	Jerome, Idaho	204	*15
KFXF	Denver, Colo.	283	250
KFXJ	†Edgewater, Colo. (near)	210	50
KFXR	Oklahoma City, Okla.	224	50
KFXY	Flagstaff, Ariz.	205	25
KFYO	Breckenridge, Tex.	211	15
KFYR	Bismarck, No. Dak.	250	*250
KGA	Spokane, Wash.	261	2000
KGAR	Tucson, Ariz.	234	100
KGBU	Ketchikan, Alaska	400	500
KGBX	St. Joseph, Mo.	288	100
KGBY	Columbus, Nebraska	222	50
KGBZ	York, Nebraska	213	100
KGCA	Decorah, Iowa	248	10
KGCB	Oklahoma City, Okla.	216	50
KGCH	Wayne, Nebraska	294	250
KGCI	San Antonio, Texas	220	100
KGCL	Seattle, Wash.	231	100
KGCN	Concordia, Kansas	208	50
KGCR	Brookings, So. Dak.	208	15
KGCU	Mandan, No. Dak.	240	100
KGCX	Vida, Montana	244	10
KGDA	Dell Rapids, So. Dak. (daytime)	254	15
KGDE	Barrett, Minn.	205	50
	(Also 40 meters, 50 watts)		
KGDM	Stockton, Calif.	217	10
KGDP	Pueblo, Colo.	224	10
KGDR	San Antonio, Texas	207	15
KGDW	Humboldt, Neb.	294	100
KGDY	Oldham, So. Dak.	207	15
KGEF	Los Angeles, Calif.	263	1000
KGEK	Yuma, Colo. (day)	263	10
KGEN	El Centro, Calif.	225	100
KGEO	Grand Island, Neb.	205	100
KGEQ	Minneapolis, Minn.	204	50
KGER	Long Beach, Calif.	216	100
KGES	Central City, Neb.	204	10
KGEW	Fort Morgan, Colo.	219	*100
KGEZ	Kalispell, Montana	294	100
KGFB	Iowa City, Iowa	224	10
KGFF	Alva, Oklahoma	205	25
KGFG	Oklahoma City, Okla.	216	50
KGFH	La Crescenta, Calif.	263	250
KGFI	San Angelo, Texas	220	15
KGFJ	Los Angeles, Calif.	213	100
KGFK	Hallock, Minn.	224	50
KGFL	Raton, N. M.	222	50
KGFN	Aneta, No. Dak.	200	15
KGFO	Los Angeles, Cal. (port.)	204	100
KGFW	Ravenna, Neb.	297	10
KGFX	Pierre, S. D. (day)	254	200
KGGF	Pichér, Okla.	207	100
KGGH	Cedar Grove, La.	213	50
KGGM	Inglewood, Calif. (port.)	204	100
	(6XAI, 66.04 meters; 50 watts)		
KGHA	Pueblo, Colo.	210	500
KGHB	Honolulu, Hawaii	227	250
KGHC	Slayton, Minn.	210	15
KGHF	Pueblo, Colo.	210	250
KGHP	Hardin, Mont.	263	50
KGO	Oakland, Calif.	**384	5000
	(Short-wave transmitter, 10 to 40 meters, 10,000 watts)		
KGRC	San Antonio, Texas	220	100
KGRS	Amarillo, Texas	244	*250
KGTT	San Francisco, Calif.	220	50
KGU	Honolulu, Hawaii	270	500
KGW	Portland, Oregon	492	1000
KGY	Lacey, Wash.	246	50
KHJ	Los Angeles, Calif.	400	1000
	(Also 104.1 meters; 50 watts)		
KHMC	Harlingen, Tex.	236	100
KHQ	Spokane, Wash.	370	1000
KICK	Red Oak, Iowa (day)	322	100
KJBS	San Francisco, Calif.	220	100
	(6XAR, 62 meters; 50 watts)		
KJR	Seattle, Wash.	349	2500
	(Also 105.2 meters; 5 to 250 watts)		
KKP	Seattle, Wash.	203	15
KLCN	Blytheville, Ark. (day)	286	50
KLDS	Independence, Mo.	270	1500
KLIT	Portland, Ore.	200	10
KLS	Oakland, Calif.	246	250
KLX	Oakland, Calif.	508	500
KLZ	†Dupont, Colo.	353	*750
KMA	Shenandoah, Iowa	395	1000
KMBC	see KLDS		
KMED	Medford, Oregon	270	50
KMIC	Inglewood, Calif.	224	250
KMJ	Fresno, Calif.	366	50
KMMJ	Clay Center, Neb.	286	*250
KMO	Tacoma, Wash.	254	500
KMOX	†St. Louis, Mo.	300	5000
	(Also 49 meters, 15 watts)		
KMTR	Los Angeles, Calif.	526	500
	(Also 108.2 meters; 250 watts)		
KNRC	Santa Monica, Calif.	375	500
	(Also 108.2 meters; 100 watts)		
KNX	Los Angeles, Calif.	337	500
	(Also 107.1 meters; 100 watts)		
KOA	Denver, Colo.	**326	5000
KOAC	Corvallis, Oregon (day)	270	7000
KOB	State College, New Mex.	395	*5000
KOCH	Omaha, Neb.	258	250
KOCW	Chickasha, Okla.	252	250
KOIL	Council Bluffs, Iowa.	319	5000
	(9XU, 61.06 meters, 500 watts)		
KOIN	†Portland, Oregon.	319	1000
KOMO	Seattle, Wash.	309	1000
KOOS	Marshfield, Ore.	207	50
KOW	Denver, Colo.	219	250
KPCB	Seattle, Wash.	231	100
KPJM	Prescott, Ariz.	214	15
KPLA	Los Angeles, Calif.	288	500
KPNP	Muscatine, Iowa.	211	100
KPO	San Francisco, Calif.	422	1000
KPOF	Denver, Colo.	201	500
KPPC	Pasadena, Calif.	316	50
KPRC	Houston, Texas	294	500
KPSN	Pasadena, Calif.	316	1000
KQV	Pittsburgh, Pa.	270	500
KQW	San Jose, Calif.	297	500
KRAC	Shreveport, La.	220	50
KRE	Berkeley, Calif.	246	100
KRLD	Dallas, Texas	461	500
KRSC	Seattle, Wash.	203	50
KSAC	Manhattan, Kansas	333	500
KSBA	†Shreveport, La.	268	1000
KSCJ	Sioux City, Iowa	244	*500
KSD	St. Louis, Mo.	545	500
KSEI	Pocatello, Idaho	333	250
KSL	Salt Lake City, Utah	303	5000
KSMR	Santa Maria, Calif.	273	100
KSO	Clarinda, Iowa	227	500
KSOO	Sioux Falls, So. Dak.	210	*250
KSTP	St. Paul, Minn.	220	*2000
KTAB	Oakland, Calif.	280	500
KTAP	San Antonio, Texas	229	20
KTBI	Los Angeles, Calif.	275	1000
KTBR	Portland, Oregon	229	50
KTHS	Hot Springs, Ark.	**384	*1000
KTNT	Muscatine, Iowa	256	2000
KTSA	San Antonio, Texas	265	2000
KTUE	Houston, Texas	213	5
KTW	Seattle, Wash.	395	1000
KUJ	Seattle, Wash.	200	10
KUOA	Fayetteville, Ark.	297	500
KUOM	Missoula, Mont.	461	500
KUSD	Vermillion, So. Dak.	484	250
KUT	Austin, Texas	232	500
KVI	Tacoma, Wash.	283	250
KVL	Seattle, Wash.	203	100
KVOO	Bristow, Okla.	349	1000
KVOS	Bellingham, Wash.	210	250
KWBS	Portland, Oregon.	200	50
KWCR	Cedar Rapids, Iowa	240	250
KWEA	Shreveport, La.	213	250
KWG	Stockton, Calif.	345	50
KWJJ	Portland, Ore.	250	50
	(Also 53.54 meters, 100 watts)		
KWK	St. Louis, Mo.	234	*1000
KWKC	Kansas City, Mo.	222	100
KWKH	Shreveport, La.	395	1000
KWLC	Decorah, Iowa	248	50
KWSC	Pullman, Wash.	395	500
KWTC	Santa Ana, Calif.	273	100
KWUC	LeMars, Iowa (day).	**244	1500
KWWG	Brownsville, Texas	278	500
KXA	Seattle, Wash.	349	500
KXL	Portland, Ore.	220	100
KXRO	Aberdeen, Wash.	224	50
KYA	San Francisco, Calif.	361	1000
KYW	Chicago, Ill.	526	*2500
KZM	Oakland, Calif.	208	100
NAA	Arlington, Virginia	**434	1000
WAAD	Cincinnati, O.	231	25
WAAF	Chicago, Ill.	389	500
WAAM	Newark, N. J.	268	250
	(Also 65.18 meters, 50 watts)		
WAAT	Jersey City, N. J.	246	300
WAAW	Omaha, Neb. (daytime)	441	500
WABC	Richmond Hill, N. Y.	309	*2500
	(Also 64.0 meters, 500 watts)		
WABF	Kingston, Pa.	205	250
WABI	Bangor, Me. (Sundays)	389	100
WABO	See WHEC		
WABW	Wooster, Ohio.	248	50
WABY	Philadelphia, Pa.	248	50
WABZ	New Orleans, La.	238	50
WADC	Akron, Ohio.	238	1000
WAFD	Detroit, Mich.	231	100
WAGM	Royal Oak, Mich.	225	50
WAIT	Taunton, Mass.	214	10
WAIU	†Columbus, Ohio.	283	5000
WAIZ	Appleton, Wis.	227	100
WALK	Willow Grove, Pa.	201	50
WAMD	†St. Paul, Minn.	222	500
WAPI	Auburn, Ala.	341	1000
WASH	Grand Rapids, Mich.	256	250
WATT	Boston, Mass (portable)	201	100
WBAA	West Lafayette, Ind.	**273	500
WBAK	Harrisburg, Pa. (day).	300	500
WBAL	†Baltimore, Md.	**286	5000
WBAO	Decatur, Ill.	268	100
WBAP	Fort Worth, Texas	500	5000
WBAW	Nashville, Tenn.	240	500
WBAX	Wilkes Barre, Pa.	250	100
WBBC	Brooklyn, N. Y.	227	500
WBBL	Richmond, Va.	234	100
WBBM	†Glenview, Ill.	**389	5000
WBBP	Petoskey, Mich.	240	100
WBBR	Rossville, N. Y.	256	1000
WBBW	Norfolk, Va.	236	100
WBBY	Charleston, So. Car.	250	75
WBBZ	Chicago, Ill. (portable)	204	100
WBCN	Chicago, Ill.	288	250
WBES	Takoma Park, Md.	265	100
WBET	Medford, Mass.	288	500
WBIS	See WNAC		
WBKN	Brooklyn, N. Y.	200	100
WBMH	Detroit, Mich.	211	100
WBMS	Union City, N. J.	200	100
WBNY	New York, N. Y.	236	500
WBOQ	Richmond Hill, N. Y.	309	500
WBRC	Birmingham, Ala.	242	250
WBRE	Wilkes Barre, Pa.	250	100
WBRL	Tilton, N. H.	232	500
	(1XY, 105, 109 meters, 250 watts)		
WBRS	See WCDA		
WBSO	Wellesley Hills, Mass.	384	100
WBT	Charlotte, No. Car.	258	*750
WBZ	†Springfield, Mass.	*333	15,000
	(Has short-wave transmitter)		
WBZA	Boston, Mass.	*333	500
WCAC	Mansfield, Conn.	535	500
WCAD	Canton, N. Y.	244	*500
WCAE	Pittsburgh, Pa.	461	500
WCAH	Columbus, Ohio.	234	250
WCAJ	Lincoln, Neb. (day).	380	500
WCAL	Northfield, Minn.	286	500
WCAM	Camden, N. J.	224	500
WCAO	Baltimore, Md.	244	250
WCAP	Asbury Park, N. J.	240	500
WCAT	Rapid City, So. Dak.	248	100
WCAU	Philadelphia, Pa.	261	500
WCAX	Burlington, Vermont.	254	100
WCAZ	Carthage, Ill.	250	50
WCBA	Allentown, Pa.	222	100
WCBD	Zion, Ill.	345	5000
WCBE	New Orleans, La.	227	5
WCBM	Baltimore, Md.	225	100
WCBR	Providence, R.I. (port.)	201	100
WCBS	Springfield, Ill.	210	250
WCCO	†Minneapolis, Minn.	**405	*5000
WCDA-WBRS	Cliffside, N. J.	211	250
WCFL	Chicago, Ill.	484	1500
WCGU	Brooklyn, N. Y.	219	500
	Also 54 meters, 150 watts)		
WCLO	Kenosha, Wisc.	227	100
WCLS	Joliet, Ill.	216	500
WCMA	Culver, Ind.	261	500
WCOA	Pensacola, Fla.	250	500
WCOC	Columbus, Miss.	231	250
WCOT	Providence, R. I.	225	100
WCRW	Chicago, Ill.	224	500
WCSH	Portland, Maine	366	5000
	(Also 63.79 meters, 250 watts)		
WCSO	Springfield, Ohio	256	500
WCWK	Fort Wayne, Ind.	214	250
WCWS	Danbury, Conn.	265	100
WCX	See WJR		
WDAE	Tampa, Fla.	268	500
WDAF	Kansas City, Mo.	370	1000
WDAG	Amarillo, Texas	263	250
WDAH	El Paso, Texas	234	100
WDAY	Fargo, No. Dakota	545	*250
WDBJ	Roanoke, Va.	231	250
WDBO	Orlando, Fla.	288	*500
	(4XE, variable, 250 watts)		
WDEL	Wilmington, Del.	297	100
WDGY	Minneapolis, Minn.	286	500
WDOD	Chattanooga, Tenn.	244	500
WDRC	New Haven, Conn.	283	500
WDWF-WLSI	Cranston, R. I.	248	250
WDZ	Tuscola, Ill. (daytime)	278	100
WEAF	†Bellmore, N. Y.	**492	50,000
WEAM	North Plainfield, N. J.	263	250
WEAN	Providence, R. I.	275	500
WEAO	Columbus, Ohio.	283	750
	(Also 54.02 meters, 250 watts)		
WEAR	Cleveland, Ohio.	**400	1000
WEBC	Superior, Wis.	242	*250
WEBE	Cambridge, Ohio	248	10
WEBH	Chicago, Ill.	366	*500
WEBJ	New York, N. Y.	**256	500
WEBQ	Harrisburg, Ill.	224	15
WEBR	Buffalo, N. Y.	242	200
WEBW	Beloit, Wis.	258	500
WEDC	Chicago, Ill	242	500
WEEI	Boston, Mass.	508	500
	(Has short-wave transmitter)		
WEHS	Evanston, Ill.	216	100
WEMC	Berrien Spgs., Mich.	484	1000
WENR	Chicago, Ill.	288	500
WEPS	Gloucester, Mass.	297	100
WEVD	Woodhaven, N. Y.	246	500
WEW	St. Louis, Mo. (day)	353	1000
WFAA	Dallas, Texas	545	500
WFAM	St. Cloud, Minn.	252	10
WFAN	Philadelphia, Pa.	224	500
WFBC	Knoxville, Tenn.	234	50
WFBE	Cincinnati, Ohio.	246	250
WFBG	Altoona, Pa.	268	100
WFBJ	Collegeville, Minn.	273	100
WFBL	Syracuse, N. Y.	258	750
WFBM	Indianapolis, Ind.	275	1000
WFBR	Baltimore, Md.	244	*250
WFBZ	Galesburg, Ill.	248	50
WFCI	Pawtucket, R. I.	242	100
WFDF	Flint, Mich.	273	100
WFI	Philadelphia, Pa.	395	500
WFIW	Hopkinsville, Ken.	261	*750
WFJC	Akron, Ohio.	227	500
WFKB	Chicago, Ill.	224	500
WFKD	Philadelphia, Pa.	248	50
WFLA	Clearwater, Fla.	517	750
WGAL	Lancaster, Pa.	252	15
WGBB	Freeport, N. Y.	246	150
WGBC	Memphis, Tenn.	229	15
WGBF	Evansville, Ind.	236	250
WGBI	Scranton, Pa.	231	250
WGBS	†New York, N. Y.	349	500
WGCM	Gulfport, Miss.	222	15
WGCP	Newark, N. J.	268	250
WGES	†Chicago, Ill.	242	500
WGHP	†Mt. Clemens, Mich.	278	750
WGL	†Secaucus, N. J.	294	1000
WGM	Jeannette, Pa.	208	50
WGMS	Minneapolis, Minn.	246	500
WGMU	New York, N.Y. (port.)	201	100
	(Also 106 meters, 50 watts)		
WGN-WLIB	Chicago and Elgin, Ill.	416	15,000
WGOP	Flushing, N. Y.	200	100
WGR	Buffalo, N. Y.	303	750
WGST	Atlanta, Ga.	270	500
WGWB	Milwaukee, Wis.	270	250
WGY	Schenectady, N. Y.	**380	50,000
	(Also on 31.4, 21.96, and sometimes 5 meters)		
WHA	Madison, Wisc.	333	750
WHAD	Milwaukee, Wisc.	270	500
WHAM	Rochester, N. Y.	*280	5000
	(Has short-wave transmitter)		
WHAP	†Carlstadt, N. J.	236	1000
WHAS	Louisville, Ky.	322	500
WHAZ	Troy, N. Y. (Monday)	306	500
WHB	Kansas City, Mo.	341	500
WHBA	Oil City, Pa.	261	10
WHBC	Canton, Ohio.	236	10
WHBD	Bellefontaine, O.	222	100
WHBF	Rock Island, Ill.	222	100
WHBL	Sheboyan, Wis.	204	*250
WHBM	Chicago, Ill. (portable)	201	100
WHBP	Johnstown, Pa.	229	*250
WHBQ	Memphis, Tenn.	232	100
WHBU	Anderson, Ind.	220	15
WHBW	Philadelphia, Pa.	220	100
WHBY	West De Pere, Wis.	250	50
WHDI	Minneapolis, Minn.	246	500
WHEC-WABO	Rochester, N. Y.	254	*250
WHFC	Chicago, Ill.	216	200
WHK	Cleveland, Ohio.	**265	*500
	(Also 66.04 meters, 500 watts)		
WHN	New York, N. Y.	395	500
WHO	Des Moines, Iowa	535	5000
WHPP	Englewood, N. J.	205	10
WHT	†Chicago, Ill.	306	5000
WIAD	Philadelphia, Pa.	288	100
WIAS	Ottumwa, Iowa (day)	322	100
WIBA	Madison, Wis.	240	100
WIBG	Elkins Pk., Pa. (Sund'ys)	441	50
WIBJ	Chicago, Ill. (port.)	201	100
WIBM	Chicago, Ill. (port.)	201	100
WIBO	†Chicago, Ill.	306	5000
WIBR	Steubenville, Ohio	250	50
WIBS	Elizabeth, N. J.	204	250
WIBU	Poynette, Wis.	217	20
WIBW	Topeka, Kan.	204	250
WIBX	Utica, N. Y.	238	*150
WIBZ	Montgomery, Ala.	231	15
WICC	Easton, Conn.	265	500
WIL	St. Louis, Mo.	258	250
WIOD	Miami Beach, Fla.	248	1000
WIP	Philadelphia, Pa.	349	500
WISN	Milwaukee, Wis.	270	250
WIVA	Norfolk, Va.	210	100
WJAD	Waco, Tex.	333	500
WJAG	Norfolk, Neb.	286	*250
WJAK	Kokomo, Ind.	234	50
WJAM	Cedar Rapids, Iowa	240	250
WJAR	Providence, R. I.	484	500
WJAS	Pittsburgh, Pa.	270	500
WJAX	Jacksonville, Fla.	341	1000
WJAY	Cleveland, Ohio	227	500
WJAZ	†Mt Prospect, Ill	263	5000
WJBA	Joliet, Ill.	248	50
WJBB	Sarasota, Fla.	238	250
WJBC	LaSalle, Ill.	227	100
WJBI	Red Bank, N. J.	263	250
WJBK	Ypsilanti, Mich.	220	15
WJBL	Decatur, Ill.	213	250
WJBO	New Orleans, La.	263	100
WJBT	†Chicago, Ill.	389	500

THE list of stations here corresponds to the latest list of licenses issued by the Radio Commission; and is subject to changes ordered by the regulating authority after March 15, 1928.

*Allowed higher daylight power, **Standard or constant-frequency transmission. † Remote Control.

(Continued on page 1251)

A Britisher Chats on Radio

A Breezy Discussion of the British Broadcasting Company, Its Listeners, Their Trials and Tribulations and What Not

By E. Blake

RECENTLY in London Town Harry Lauder gave a farewell broadcast to Britain, before setting out for a tour of the United States of America. He has said here that he does not expect to broadcast in your country; I think he has some notion that he will be unable to roll his r's properly if his "turn" should be sandwiched between a coon song and an advertisement relating to "Zeilweiger's Zero Cold-drawn Molasses;" but I have a bet on that Harry will risk it if some of your Broadcasting people begin to talk figures. Harry will roll his r's for "dough," charity or friendship; but never for his health alone.

Among other candid confessions he told us that he had been saving hard; so hard, in fact, that he had not bought a box of matches for a year. Being an amateur statistician I began to calculate what he had saved by that self-denial, on the assumption that he uses one box per day; and this led me easily to an estimate of what the English, who evidently supplied him with his matches for nothing, must have lost. And then I came to the solar plexus of our economic system—money; a delicate point!

THE GOLDEN HOARD

We have no gold worth mentioning, except our souvenirs. What are our souvenirs? It's like this; when in 1916 I learned that the War Office was to appoint a committee to consider the advisability of destoning the troops' plum jam, I realised that the war was going to last for a long time. So I, in common with a lot of other people wrapped a golden sovereign (£1 or four-point-something dollars) in paper, together with a golden half-sovereign, and locked them away in a safe "for auld lang syne." These coins are nowadays produced on Sunday evenings before the astonished eyes of my children (born since 1914) while I tell them the story of the bygone English "quid" and its departed glory.

But we have lots of paper money and very handy it is. It has no such a nice, rich golden feeling as the sovereigns, but is much safer and easier to carry. And print is cheap. So we have no lack of pound notes and, as I heard a man in the Waldorf bar say today, "there's enough boodle blued (*i.e., spent*) per annum on radio in England to keep the northern Mexican border quiet for a week." A sad-faced fellow (gink or guy) who had just walked across from the Bush Building opposite—an American, I believe—lowered his glass of barley-water and said, "Yup! And if it were spent on the supply of ice-water and bathrooms in your English hotels it would cement the friendship of the English-speaking peoples for *haff* a century."

Here follow a few figures, worked out by the writer, confirmed by slide-rule, checked by the Astronomer-Royal, and guaranteed by King George Fifth.

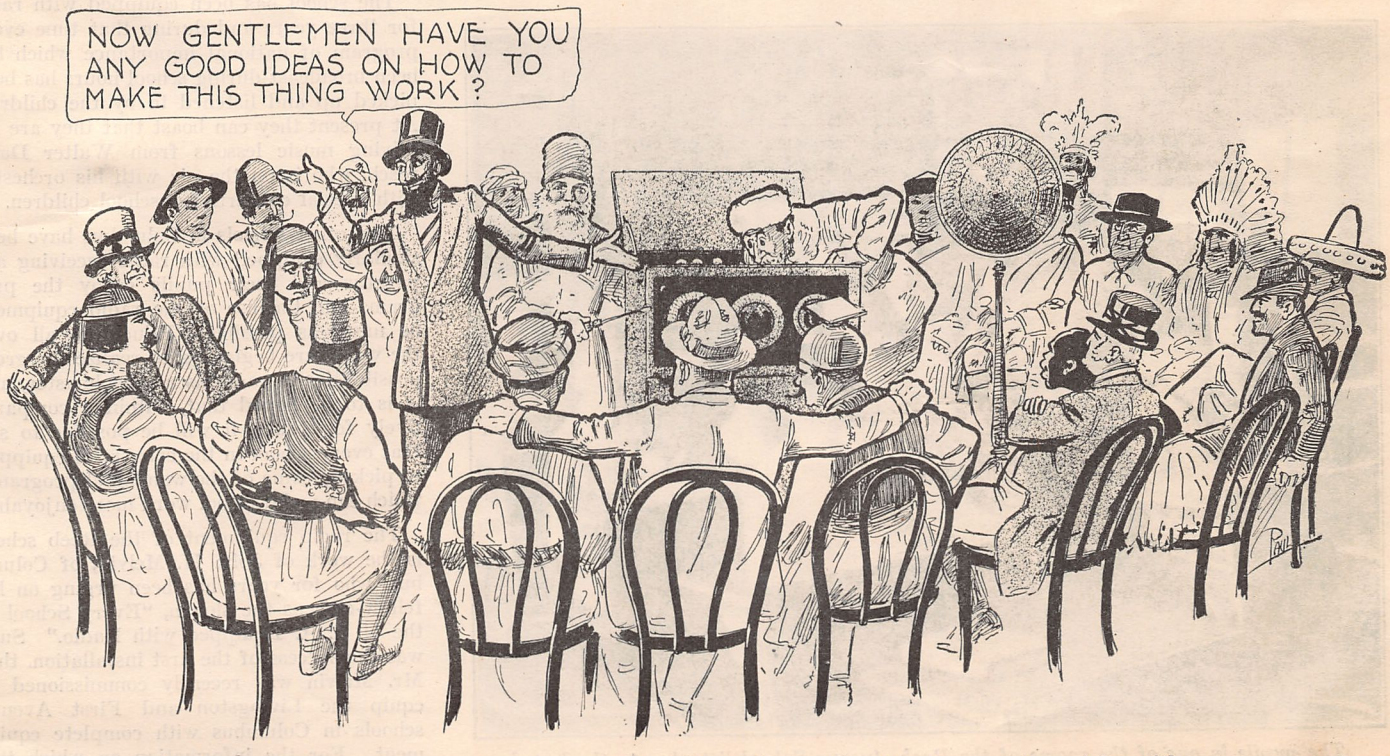
A NATION'S EARS

At the end of November, 1927, the number of licensed radio receiving sets in Britain was 2,355,600; which is equivalent to one set per 14 head of population, including Swiss waiters, Belgian barbers and Greek ice-cream magnates. (Yes, we have them here too!). That, as we say here, is not so dusty. It means that we use one set for every 3.63 families, not counting the boarders or "lady helpers."

Blind persons in this country do not pay license fees; 10,200 free licenses have been issued to the blind, and most of their apparatus has been given to them by radio manufacturers.

With such an enormous amount of listening going on in a small community, it is not surprising that our anthropometricians report that last season's crop of population (young Brits) shows distinct signs of evolution towards "elephant's ear." It is estimated that in five years our schoolboys will not need to wear collars and that washing behind the ears will have become a national problem. This is all on the assumptions that we don't have to fight the Chi-

(*Continued on page* 1266)



When there's a millivolt lacking on the grid the whole world's akin; the "wop" condoles with the "dago" and the "squarehead" with the "chee-chee." Radio is the real League of Nations.

Radio in a School Teaches Thrift to Its Pupils

Good Habits, as well as Scientific Knowledge and an Appreciation of Current Events, Are Inculcated by Aid of Excellent Installation, which also Entertains

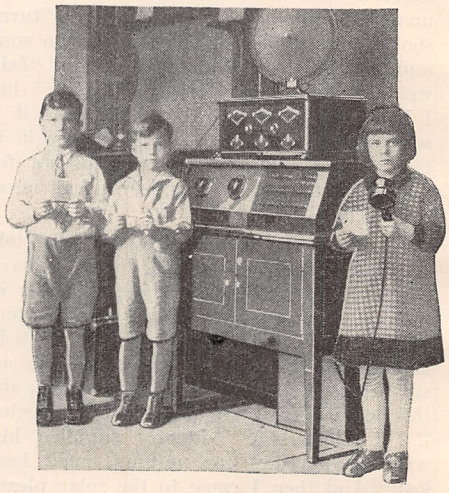
IF someone were asked to write down five maxims dealing with good habits, it seems safe to say that at least two of these would be on those of prudence and saving money. There is little doubt that, if the excellent habit of thrift can be made a part of the economic life of the children, they will grow up into better and more self-reliant citizens.

Following this course of reasoning, the authorities of the Reeb Avenue School in Columbus, Ohio, have utilized their very elaborate radio system to encourage saving among the students. They have had a complete radio receiving system installed in the building, each of the twenty-five class rooms being provided with a loud speaker. The radio apparatus proper, which is housed in a cabinet (see illustration) in the principal's office, consists of two receivers, one suited for the broadcast waveband and the other for short-wave work. The latter set is intended for use when a proposed short-wave transmitter is placed at some central location, so that the schools can broadcast their own programs; and may serve also for foreign reception, as short-wave programs increase. There is contained in the cabinet also a power amplifier operating from the light lines, and a switchboard which permits the programs to be sent to any room. All the wires to the class rooms are hidden in the walls, each terminating in a wall receptacle into which the loud speaker is plugged. A microphone also is included in the equipment, and thereby it is made possible for anyone to address the entire school from the principal's office.

As the auditorium is too small to accommodate all the classes at one time, there is on the stage a microphone from which portions of the programs, such as will interest other classes, can be sent to them. Two loud speakers are installed in the auditorium to furnish a background of music for entertainments, school plays and public assemblies. If no appropriate radio program is available, phonograph records played in the office supply the music through the loud speakers. Music for entrance and dismissal into the auditorium is furnished by a large loud speaker in the hall.

THE CAMPAIGN FOR SAVINGS

By the use of the microphone and the switchboard, any room or any combination of rooms may be addressed from the office. Every Wednesday morning, which is "bank day" at the Reeb Avenue School, a representative pupil from each class room broadcasts to the school his or her room's standing in the percentage of deposits made. Each class room has "station call letters," which are the initials of a thrift slogan. Some of these slogan are: WSOM, We Save Our Money; WATC, We Are Thrifty Children; WSP, We Save Pennies; WSAH, We Save And Have; MTAH, Make Thrift A Habit; SABH; Save And Be Happy; GCS, Good Citizens Save; SFTF, Save For The Future; and many others of like nature.

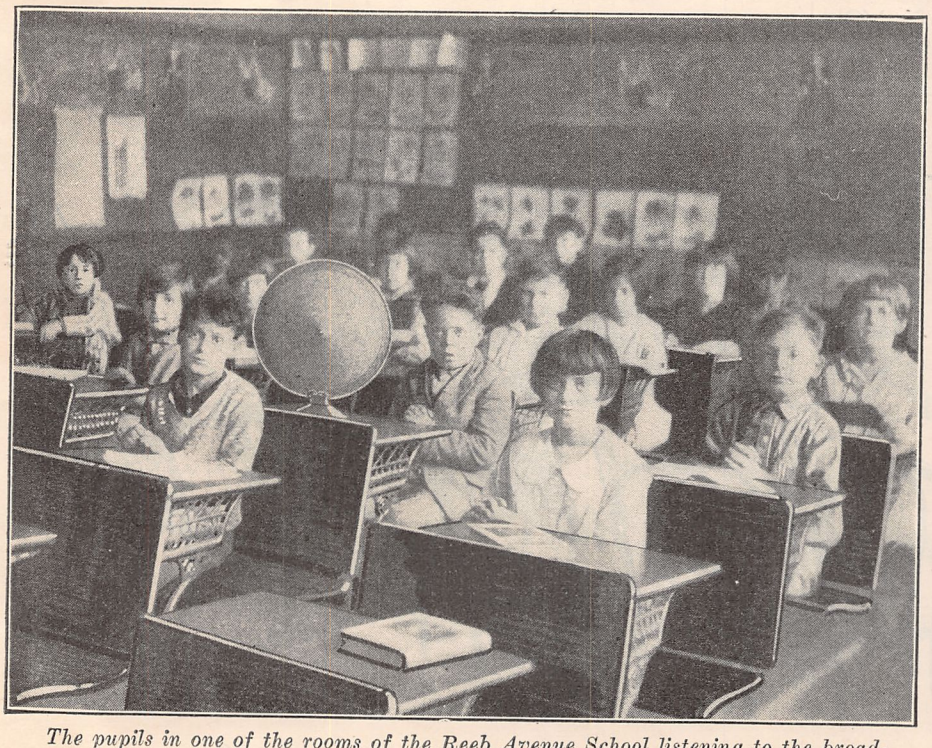


One of the thrifty young ladies, Miss Anna Peterfy, is broadcasting to her fellow-pupils the bank standing of her room. The radio equipment is in the background.

The school has been equipped with radio for three years and during that time every program of national importance which has been broadcast during school hours has been picked up and listened to by the children. At present they can boast that they are receiving music lessons from Walter Damrosch, who is on the air with his orchestra with special concerts for school children.

Two other schools in Columbus have been similarly equipped with radio receiving apparatus and their pupils enjoy the programs and the use of the radio equipment as much as possible. Educators all over the world are beginning to realize the great possibilities in radio as a schoolmaster, and it is to be hoped that, within a comparatively few years, it will be possible to say that every school in the country is equipped to pick up some of the wonderful programs, which can make school work more enjoyable.

The radio equipment of the Reeb school is the work of John H. Melvin, of Columbus, who for years has been urging on his fellow-citizens the slogan, "Every School in the U. S. A. Equipped with Radio." Such was the success of the first installation. that Mr. Melvin was recently commissioned to equip the Livingston and First Avenue schools in Columbus with complete equipment. For the information on which this article is based, RADIO NEWS is indebted to Principal W. C. Dyer of the Reeb school.



The pupils in one of the rooms of the Reeb Avenue School listening to the broadcasting of their fellow pupils, who are reporting the bank standings in the schools.

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Radio Polices A Western City

How Berkeley, California, Police Headquarters Communicates With Patrolmen Throughout the City by Short-Wave Radio

By J. E. Squires

AN entirely new and scientific method of policing his jurisdiction has been devised by Chief of Police August Vollmer, of Berkeley, and is now in permanent use in that California city. By this means, instructions are conveyed instantaneously to patrolmen in all parts of the municipality; and one or all of the police force may be called so quickly to a given point that, in actual tests they have arrived in three minutes, though the time limit given was five minutes.

This new and novel method of directing a police force is short-wave radio. All the patrolmen of Berkeley, a city of 80,000 inhabitants, are mounted in automobiles, the majority of the cars being small, high-speed roadsters. On each of these has been installed a radio receiving set, with headphones, a loud speaker on the dashboard, and flashing red neon-gas lamps on the dash and on the outside of the rear of the car. Two distinct methods of communication are employed, one by signals made in code with a Morse key at the central broadcast station in police headquarters, appearing on the flashing red lamps on the cars; and the other by speech through either of two microphones, one in the office of the chief of police, and the other on the desk of the captain or sergeant on duty.

In case the patrolman should be away from his car, watching a building or a person, the red lamp on the outside of the car flashes instructions to him, or calls him to the car, where he can hear general instructions through the loud speaker, or secret orders through the headphones, as the red lamp and its code may direct. In case he is inside the car, the flashing of the lamp on the dash directs him to put on the phones, or transmits other instructions; or the loud speaker may give him general orders when there is nothing secret about them. It has been found that, by means of the red lamps and the code (in which all the patrolmen have been thoroughly instructed), involved orders can be given instantaneously, or the men can be called to any point in the city, without speaking to them.

The broadcasting is done on a 160-meter wavelength, which several months of experiment in 1927 proved to be the most efficient. It has been found that the messages are conveyed clearly, either by voice or by signal, to patrolmen in their cars while traveling at speeds up to sixty miles an hour. By a system of selective sending, devised by one of the members of the Berkeley police force (all of whom, by the way, are university graduates), any desired number of patrolmen, from one up, can be called and instructed, without the need of talking to or signalling the other members of the force.

Up to the end of 1927, it was necessary, in all American cities, to call patrolmen to a point where they were needed by special messenger, telephone, or other slow means, resulting in the escape of many criminals in those few precious minutes between the discovery of a crime and the arrival of the officers. Now, the patrolman can be called instantly, within a few seconds after police headquarters is advised of a crime, and, in a few seconds more, can be on his way to the scene of the crime, thereby cutting down tremendously the "escape time" of the crook.

The broadcast station in the police headquarters, at Berkeley, has a rating of fifty watts. Direct current at 1,200 volts is used to actuate this set, being built up from the 110-volt alternating-current city line by a transformer working through a chemical rectifier. The aerial is of the L-type, with four 50-foot lengths of wire, and a counterpoise consisting of an equal number of wires of the same length. The transmitter is handled also by a remote control directly under the hand of the telephone operator in the central station.

The receiving sets in the patrolmen's automobiles are locked after being tuned to the fixed 160-meter wavelength; so that there are no dials or other controls for the officer to adjust. They are five-tube receivers, each with loud speaker, and available headphones for secret communications.

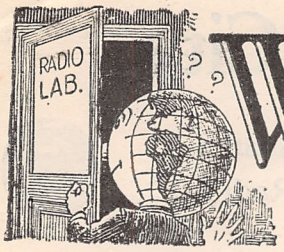
The sending set is so constructed that an operator, wishing to call a patrolman, presses a button for his "radio number," whatever it may be, and the set starts calling that number auto-

(*Continued on page* 1264)

The patrolman can receive a message without taking his hand from the wheel, while traveling at full speed.

The sergeant on duty at police headquarters at Berkeley, Calif., has under his hand buttons each of which will light a red signal lamp in a patrolman's car. He can thus send a flashing signal in code; or direct the patrolman to listen in through phones or turn on his loud speaker.

The 160-meter transmitter of the Berkeley police department, used by the chief or captain on duty for voice or telegraphic communication with officers on the automobile patrol. Every man on duty is thus under the control of headquarters for instantaneous mobilization.



What's New in Radio

Names and addresses of manufacturers of devices described in this department may be obtained by writing to the "I Want to Know" department of RADIO NEWS.

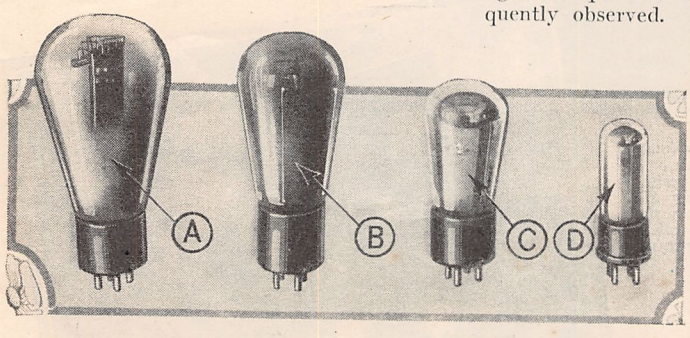
Power Tube Designed for Larger Output

A NEW power-amplifier tube, which has a far greater output than any tube previously designed for reception purposes, has recently been developed. The tube is known to the radio trade as the 250 type and it has a maximum output of 4,650 milliwatts; that is to say, the 250-type tube is capable of delivering more energy than two 210-type tubes connected in a push-pull circuit, or it can produce 6.6 times as much undistorted output as a single 171 type and three times as much as the 210 type. The tube has been designed primarily for use in conjunction with auditorium loud speakers where enormous volume is required; and it may be used for the operation of a plurality of loud speakers in hospitals and exposition work where a number of reproducers are supplied with energy from a common amplifier. Also, it is ideal for use in a roomy home; as the tube may be operated with low potentials at only a fraction of its maximum output. In this way it is possible to insure ample reserve power, thus guaranteeing distortionless output at all times.

The chart below shows the electrical characteristics of the 250-type tube for various values of plate voltage:

	Recommended				Max.
Plate voltage	250	300	350	400	450
Grid voltage	45	54	63	70	84
Plate current (MA)	28	35	45	55	55
Plate resistance	2100	2000	1900	1800	1800
Mutual conductance	1800	1900	2000	2100	2100
Amplification factor	3.8	3.8	3.8	3.8	3.8
Output (Milliwatts)	900	1500	2350	3250	4650
Filament voltage ..	7.5	7.5	7.5	7.5	7.5
Filament current ..	1.25	1.25	1.25	1.25	1.25

In size the new tube is considerably larger than the 210 type (6½ inches in height and 2 11/16 inches in diameter), but it is mounted on a standard UX-type base.



This illustration shows the comparative sizes of the new 250-type power-amplifier tube and other standard receiving tubes; A, 250-type; B, 210-type; C, 201A-type; and D, 199-type. The new tube has an undistorted output of over 4½ watts, or approximately three times that of the 210-type tube.

The filament is of the rugged oxide-coated ribbon type, which operates at a dull red heat. The current for heating this is usually obtained from a 7½-volt winding of a power transformer; and the design of the transformer should be such that, with normal line variations, the voltage applied to the filament is maintained within 5% of the rated value. The plate of the tube is blackened, and is tall and narrow, as in the 281-type rectifier.

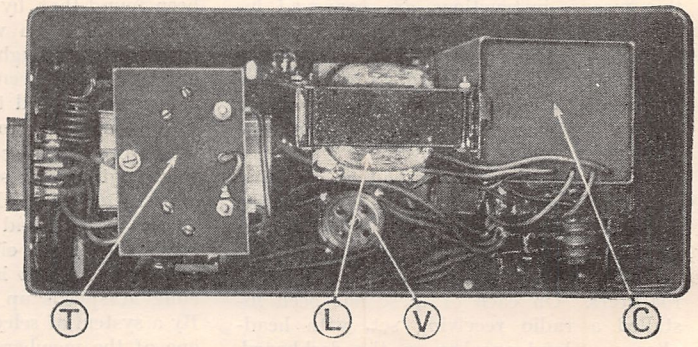
In operation the new tube should preferably be mounted in a vertical position, and provision should be made for sufficient air circulation (natural) to prevent overheating. Because of the high plate voltages used *the power supply should always be turned off when the tube is inserted or removed from the socket, or when adjustments are made to the circuits.*

By using low plate voltages the life of the tube may be greatly increased; and this is always recommended where the volume requirements are such that the maximum outut of the tube is not essential. A plate potential of 350 volts permits greater output than is usable in most installations. In cases where maximum plate voltage is used, the receiver design should be such that, even during the maximum expected line-voltage variations, the plate voltage will not exceed 450.

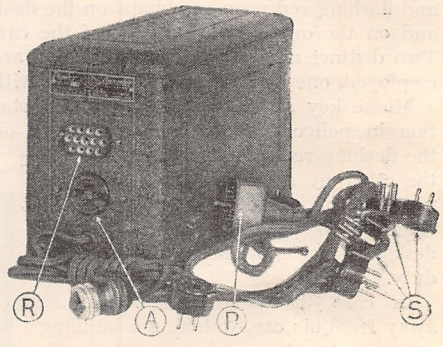
When deciding upon the plate voltage to be used it should always be remembered that the use of a high potential does not in itself appreciably increase the volume, but only allows greater volume without distortion. Also, it should be remembered that, when operating the tube at maximum voltages, the plate of the tube should be frequently observed. Plate temperatures exceeding a dull red heat indicate an excess of plate current, which may be caused by an overload of plate voltage or insufficient grid-bias voltage. Always, when operating this tube, it is essential to make sure that the grid-bias potential is of the correct value for the plate voltage used. It is also necessary to make sure that a coupling device (output transformer) is connected between the plate circuit of the tube and the loud speaker.

Power Converter Simplifies Receivers

A COMPACT and ingenious device recently placed on the market, makes it a very simple task to convert a battery-operated set into an electric set using the new A.C. tubes. The change may be accomplished *without changing a single wire in the old set,* and little technical knowledge is required. The device manufactured for this purpose is known as an "A-B-C" converter, and may be used in connection with any ordinary five-, six- or seven-tube receiver.



The parts shown in this internal view of the "A-B-C" converter are: T, step-down transformer; L, filter chokes; C, filter condensers; V, rectifier socket. It may be connected to a receiver without any wiring changes.



External appearance of the new "A-B-C" power converter, with wiring harness.

Pictures on this page show the appearance of the new converter. It is housed in a metal case only 5 x 7 x 11 inches, and is comparatively light in weight; yet this unit provides all filament, plate and grid potentials required by the receiver. In construction it is somewhat similar to the standard "B" power unit using a full-wave rectifier. Of course, three extra windings have been incorporated in the power transformer, to heat the filaments of the tubes in the set; and resistors have been added.

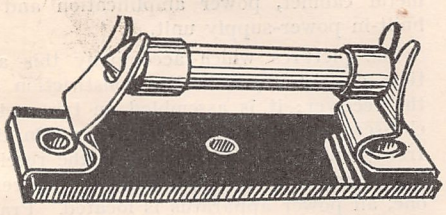
In the picture it will be noticed that, alongside the power unit, there is a wiring harness to which are attached a number of small plugs (S) which fit into vacuum-tube sockets. It may also be seen that at one end of the harness is provided a large plug (P) which fits into a socket (R) in the power unit.

To convert a receiver from D.C. to A.C., the old D.C. tubes are removed from the

sockets and the plugs (S) on the wiring harness are fitted into the sockets instead. One of the plugs is of special design and must be inserted in the detector socket, and another can be used only in the last audio stage; while the other plugs may be distributed as desired among the remaining sockets. Next, a 227-type tube is inserted into the plug placed in the detector socket; a 171-type tube is placed in the plug in the last audio-stage socket; and 226-type tubes are inserted in the remaining plugs. The "B" circuit may now be completed by connecting the binding posts of the set with the free wires of the harness which are similarly marked. As grid-bias is automatically provided, all "C-battery posts of the set must be short-circuited. The plug (P) at the other end of the wiring harness may then be inserted in the socket (R) on the power unit, and the conversion is completed.

Before operating the set, a new switch must be provided, as the old filament switch no longer has any effect on the circuit. A cord and plug is provided with the power unit and any 110-volt switch may be connected to this cord. To connect the switch into the circuit, it is necessary only to insert the plug into the socket (A) provided on the power unit. Also, it may be found that the change renders the volume control of the receiver useless; and, if this is the case, a new one must be provided. For this purpose a variable high-resistance unit may be connected across the aerial and ground binding posts of the receiver.

To place a receiver in operation after the changes described above have been completed, it is necessary only to connect the power unit with the light socket and snap the switch. The receiver will operate as before, and no other adjustments are necessary.



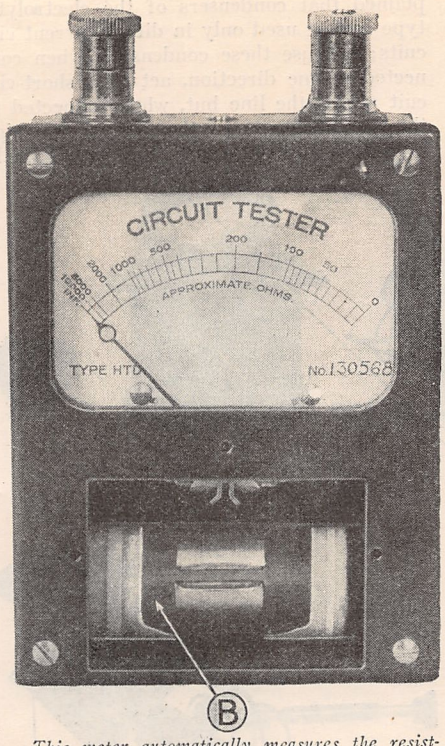
This new grid-suppressor resistor fits in any standard grid-leak clip.

"Grid Suppressors" are Now Made in Handy Tubes

IN the design of modern tuned-radio-frequency receivers, the "grid suppressor" has been quite generally employed, by set constructors and radio manufacturers, to prevent oscillations in the R.F. stages. In well-designed sets, this method has produced entirely satisfactory results, and such receivers are very stable in operation over the entire broadcast waveband. However, faulty application of this system has been the cause of a considerable amount of grief in some instances. Usually, poor results are caused by the *inductance and capacity* of the resistors used; and, when such a condition exists, it is most difficult to determine the reason for the unstable operation of the receiver.

A "grid-suppressor" unit, to accomplish its purpose, should be as nearly as possible free from inherent inductance and capacity. If a measurable amount of inductance is present, it is almost certain to affect the circuit, as well as to nullify the advantages sought in the use of the grid suppressor. It is the sole purpose of such a component to provide a "pure-resistance" load in the grid circuit; and the apparatus which accomplishes this, without introducing appreciable inductance or capacity, best answers the requirements of the set builder. The ohmic value of resistors suitable as grid suppressors varies with different types of sets; however, in most cases, the resistance of the units must be between 250 and 3,000 ohms.

A resistor of a new type is illustrated on this page; it is similar in appearance to a standard grid leak and fits into a standard grid-leak mount. It is short, hermetically-sealed, and of metallized-filament construction and, consequently, free from troublesome inductive or capacitive effects. It is available in a large number of values between 250 and 3,000 ohms.



This meter automatically measures the resistance of an electric circuit in ohms without the necessity of an external battery. B is a small flashlight cell.

Simple Instrument Measures Resistance of Circuits

SERVICE men will find a new meter, recently placed on the market, a great aid to them when trying to locate trouble in radio receivers. The meter is known as a "circuit tester," and indicates the approximate ohmic resistance of the circuit in which it is connected, without the use of an external battery. Although the readings of this meter are not to be compared with laboratory precision measurements, they are sufficiently accurate to be of great service to the radio repair man.

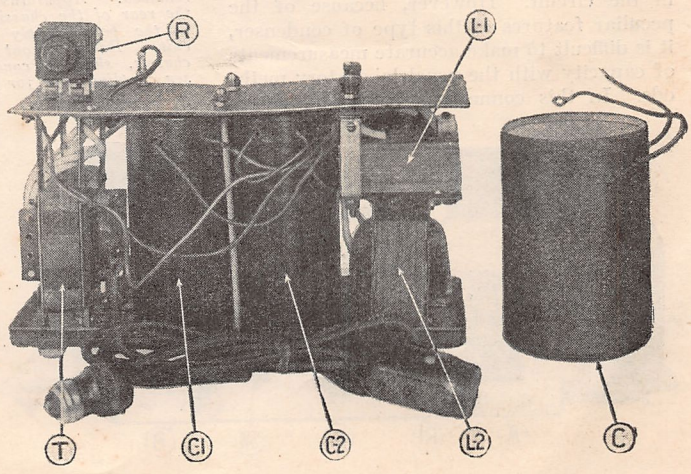
When computing the resistance of a circuit by the usual methods, three instruments are required: viz., a voltmeter, an ammeter and a battery. The voltmeter is inserted *in shunt* with the instrument or circuit to be measured, and the ammeter is inserted *in series;* while the battery is so connected that a current passes through the circuit. To determine the resistance, the current and voltage readings must be made simultaneously on the voltmeter and ammeter, and these measurements must be substituted in the "Ohm's Law" formula; *i.e.,* resistance is equal to voltage divided by current. To make a measurement in this way, considerable apparatus is needed; and it takes time and trouble to connect up the apparatus, make the measurement and solve the formula.

In the meter described here, a small 1½-volt flashlight battery is located inside the case, directly behind the name-plate; its location is clearly shown in the illustration, which pictures the meter with the name-plate removed. The meter and battery are connected in series, and the free terminal of each is connected to one of the binding posts. Therefore, when the two binding posts of the meter are connected to two ends of a resistance, there is formed a series circuit consisting of the meter, the battery and the resistance. As the voltage of the battery is known, it is possible to graduate the scale of the meter in ohms, and in this way save the service man the trouble of making computations. In the case of the meter under discussion, it is possible to make approximate measurements of circuits whose resistance is not less than one ohm and not more than 100,000 ohms.

It is not difficult to find hundreds of useful ways in which such a meter may be used when testing radio receivers. For example, one can detect open circuits, short-circuits, defective apparatus, etc. It is also possible to determine which is the primary winding of an audio transformer, and many other facts of a similar nature.

"Dry-Electrolytic" Condensers Used in "A" Power Units

THE design of a suitable filter system has been one of the most difficult problems for radio engineers to solve, in connection with the construction of "A" power-supply devices. In low-voltage devices of this type which operate from a 60-cycle source of alternating current, the capacity



"A" power units of compact construction are made possible by use of the new "dry-electrolytic" condensers, which house an enormous capacity in a very small space.

required in the filter circuit is in the order of several thousand microfarads; and for this reason the use of paper condensers is out of the question. The cost of a paper condenser having a capacity of 5,000 mf., for example, would probably be several thousand dollars; and, in addition, the filter would weigh several hundred pounds and would require many cubic feet of space.

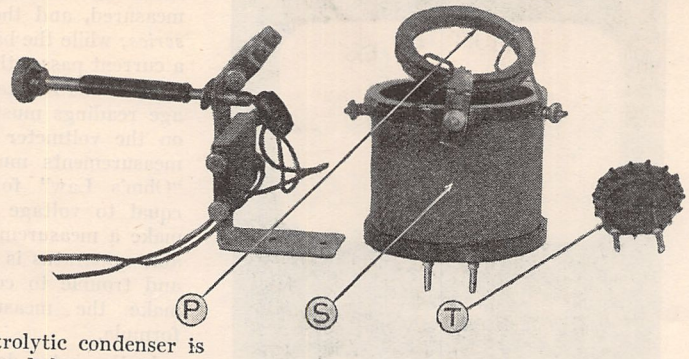
In their search for a suitable solution of this problem, engineers have developed the electrolytic condenser; and devices of this type are now giving excellent satisfaction in thousands of commercial "A"-power units. The electrolytic condenser is compact, inexpensive, and has ample capacity for the purpose; and was at once thought the ultimate solution to the problem. However, notwithstanding this invention, engineers have continued their search for an ideal condenser.

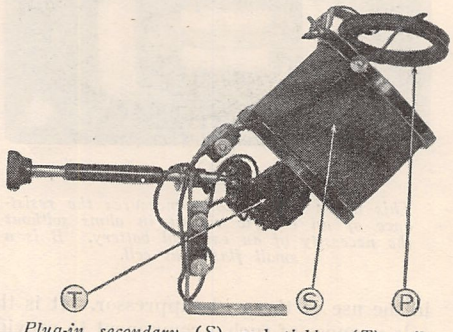
The "dry-electrolytic" condenser is a new development which is exciting interest throughout the entire industry. It is a "chemical" unit, capable of providing enormous condenser capacity in a very small space; yet it does not use any liquids nor require any attention after it has been installed.

The picture on page 1225 shows an "A" power-supply unit of very compact design which uses two of the new dry-electrolytic condensers; and, at the right of the power unit, one of the new condensers is shown. The condenser is hermetically sealed in an oval can, 2¾ by 4 inches, by 6 inches high; inside the can are two strips of aluminum foil, each of which is 4 inches wide, 68 inches long, and .009-inch in thickness. The two pieces of foil are separated by strips of paper which have been impregnated with a chemical which causes an electrolytic action. The two strips of aluminum separated by the paper are coiled up and make a total of 10½ turns.

The picture gives a clear idea of how compact an "A" power device may be constructed by using these condensers; the unit illustrated fits into a metal case 4½ x 8½ x 11½ inches. In the picture, T indicates the power transformers; L1 and L2 are the choke coils; C1 and C2 the electrolytic condensers; and R is a full-wave dry-electrolytic rectifier of a new type.

The electrolytic condenser illustrated has an effective capacity stated to be approximately 1,250 mf., when properly connected in the circuit. However, because of the peculiar features of this type of condenser, it is difficult to make accurate measurements of capacity with the usual laboratory methods. In this connection, it should be explained that condensers of the electrolytic type can be used only in direct-current circuits; because these condensers, when connected in one direction, act as a short-circuit across the line but, when connected in the opposite direction, they offer a very high resistance and there is no appreciable leakage of current on low voltages. In operation, these condensers may be used on only low voltages; but, should one accidentally break down from an overload in voltage, it will heal itself when connected to a low-voltage source.





Plug-in secondary (S) and tickler (T) coils are a salient feature of the new three-coil coupler pictured above. (P) is the primary.

Plug-In Coils Used in New Coupler Unit

THERE are a great many listeners who wish to have the opportunity of receiving broadcasting, and the opportunity as well to receive signals which are transmitted on other wavelengths. For example, the wavelength range to which the average American broadcast receiver responds is approximately 200 to 550 meters; but there are many excellent programs which may be heard on wavelengths below 200 meters, and most high-power European broadcasts are carried on on wavelengths above 550 meters.

Of course, there have been in the past systems for increasing the wavelength range of radio receivers; but the methods used do not measure up when compared with present-day standards of efficiency. Before the days of broadcasting "honeycomb" coils were used for this purpose, and a different set of coils was utilized for each wave band. However, these coils are not very satisfactory on waves below 600 meters and for this reason have not been popular in broadcast receivers. Other methods required the use of large shunt condensers or loading coils; but these also were intended primarily for use on long waves.

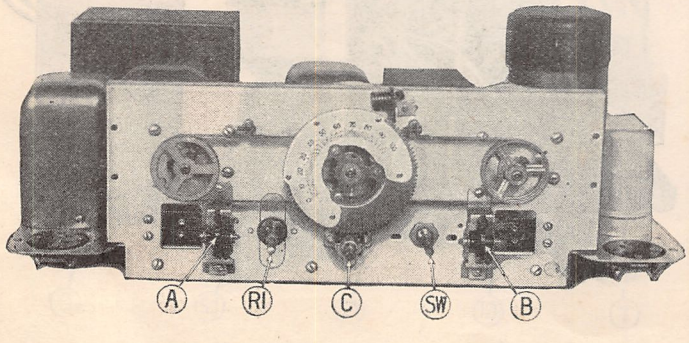
Accompanying this article is an illustration of a new type of regenerative tuner which has been designed especially for use in receivers intended to cover several wavebands. In appearance the coupler is identical to the standard design used generally in this country for broadcast reception. However, it is so constructed that the secondary and tickler coils may be removed and others substituted for shorter or higher wavelengths. Electrically the unit has the same efficiency as standard types of similar design, but its use makes possible the more convenient construction of a receiver with a universal wavelength range. It is of Austrian manufacture.

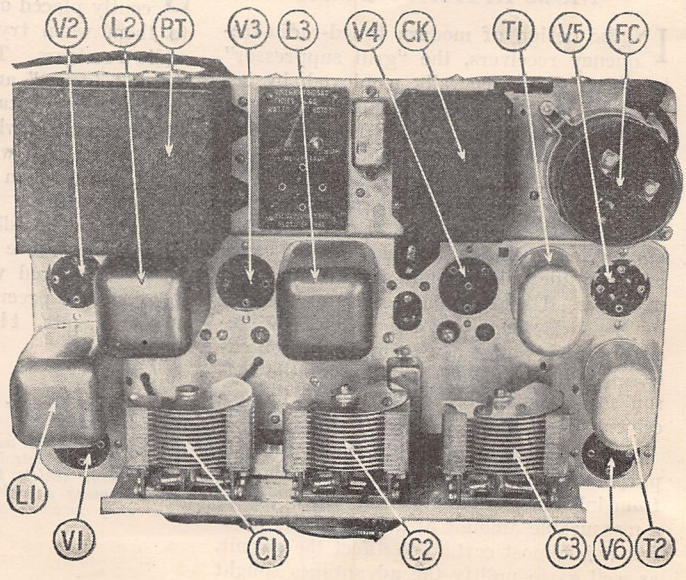
New A. C. Set is Example of Modern Design

THE receiver illustrated on this page is an interesting example of an inexpensive, but completely modern, all-electric radio set; it features single-control tuning, chassis construction, complete shielding, a metal cabinet, power amplification and a built-in power-supply unit.

The pictures which accompany this article clearly illustrate the construction of the receiver; it is assembled on two metal chasses, firmly attached together. On the front chassis, the parts used in the receiving circuit are mounted and, on the rear one, all power apparatus is located. Practically all wiring is located beneath the assembly and, in this way, the appearance of the receiver is greatly improved. Also, the receiver unit includes a structural panel

Two views of a modern all-electric six-tube receiver. Right—Top view of chassis, with shielding removed. Apparatus at the rear of the chassis is in the power-supply circuit. Below—Front of chassis, showing condenser coupling gear for single control.





for mounting the various tuning units. This is necessary because the front panel of the receiver is part of the metal cabinet and cannot be removed with the chassis.

The assembled set is shown, in the front view on page 1292, with receiver and power unit completely enclosed in the metal cabinet. The knob C, in the center of the panel, turns the illuminated vernier dial which controls the three tuning condensers of the set. This is the only wavelength control in the receiver. The switch turning the set on and off is controlled by the knob marked "Sw," and the volume-control knob is located at R1. The levers A and B adjust small compensating condensers which are used only for making critical adjustments when receiving distant stations.

Another picture on page 1226 shows the appearance of the receiver chassis when viewed from the front, and especially the small metal panel on which the tuning instruments are mounted. Three pulleys have been attached to the shafts of the three variable condensers, and coupled together for single-control operation by belts of copper ribbon. (In the case of the center condenser the pulley is concealed by the scale of the dial.) Holes have been drilled in the front panel of the cabinet to pass the shafts of the various instruments. These are independent of the front panel, but it is necessary to remove their knobs to take the chassis from the cabinet, or replace it.

In the top view of the chassis, the shielding around the variable condensers has been removed to show the construction. In this picture, L1, L2 and L3 are the three R.F. transformers; C1, C2 and C3 the three tuning condensers; T1 and T2 the A.F. transformers. V1 to V6 are the sockets for the tubes in the receiving circuits; PT is the power transformer; CK the filter choke coils; and FC is the electrolytic filter-condenser bank.

$100.00

To a Set Builder

RADIO NEWS is paying, each month, $100 to the constructor or set builder who submits the best radio circuit or constructional development, which will be printed as a "Blueprint Article." It will pay also for a patent taken out in the inventor's name, if the idea is patentable. The apparatus must have been assembled and operated by the experimenter, and the product of manufacturers' laboratories will not be considered. Send photographs and schematic circuit with your entry; but do not send the apparatus until it is asked for. Other rules of this competition appear on page 1119 of Radio News *for April. Address Editor, Monthly Construction Feature,* Radio News, *230 Fifth Avenue.*

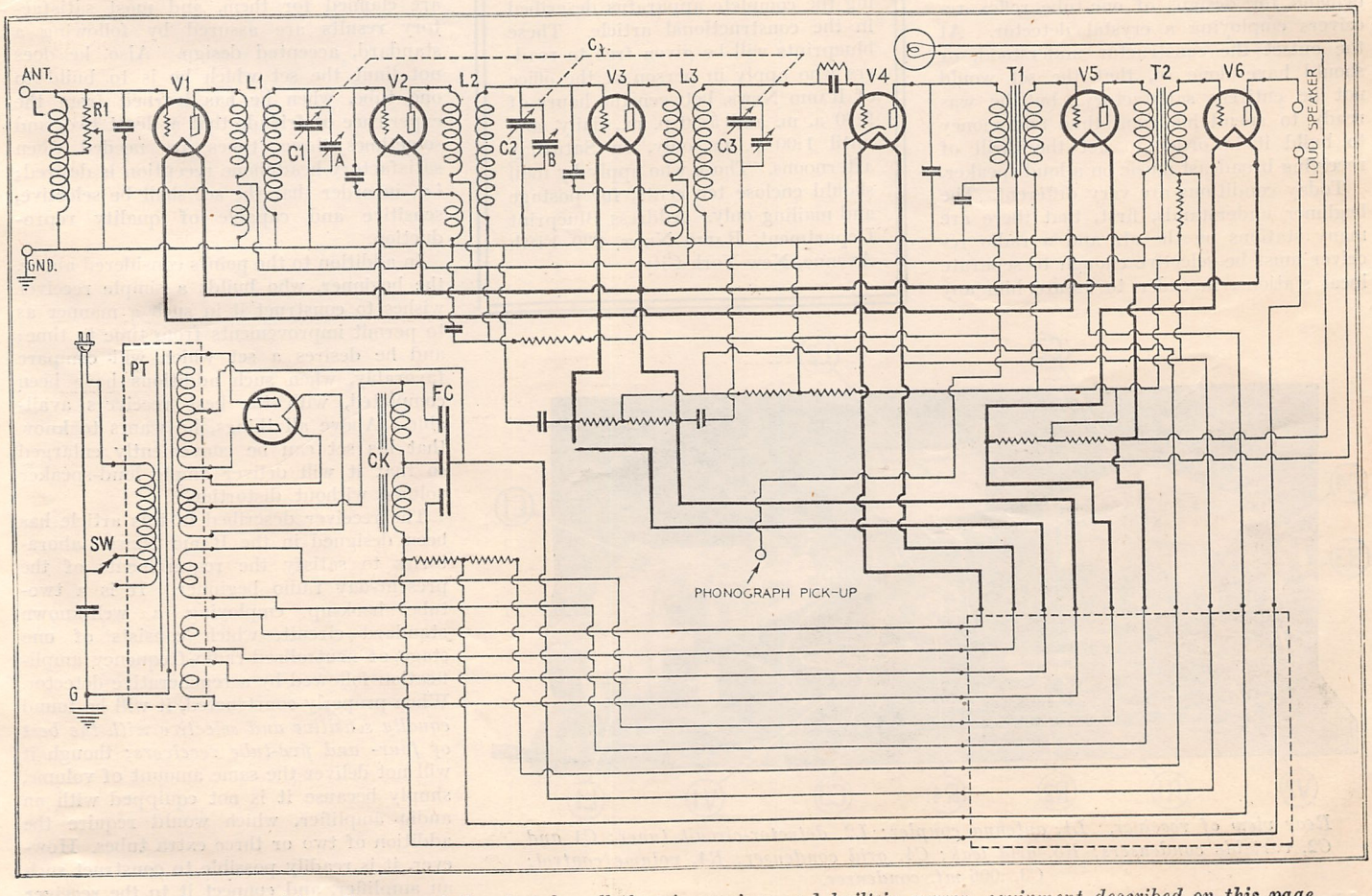
THE CIRCUITS

The wiring diagram on this page shows the complete electrical circuit of the set, including the power-supply unit. It will be seen that the receiver includes one untuned stage of R.F., followed by two tuned stages, a non-regenerative detector and two stages of transformer-coupled A.F. amplification. The plate current is supplied by a power transformer and rectified, in this model, by a full-wave tube of the filament type. The filament current for the receiving tubes and the rectifier is supplied by four low-voltage windings in the power transformer. The R.F. stages of the receiver and the first A.F. stage use four A.C. tubes of the 226 type; the detector circuit a 227-type A.C. tube; the last audio stage a 171-type power tube; while the rectifier is a 213- or 280-type tube.

It is interesting to note that the grid of the first tube is directly coupled to the antenna, across an untuned choke coil, and that the receiver's volume is regulated by a variable resistor connected in shunt across a section of this coil. This system is used to keep the tuning operation as simple as possible. If the antenna circuit were tuned, it would necessitate the use of an additional tuning control to obtain maximum efficiency. The second and third R.F. stages are tuned, and in these oscillation is prevented by use of the standard neutrodyne circuit. The circuit of the detector and audio stages is standard transformer coupling.

All voltages required for the operation of the tubes in this receiver are supplied by the power unit, and the set is turned on and off by a single-pole switch connected in series with the 110-volt A.C. supply wires, which run directly to the primary winding of the power transformer. This transformer has five windings; one for high-voltage (plate-power) supply, and four for the different filament voltages. After the plate current has undergone full-wave rectification, it is delivered to the filter, which consists of a double choke coil (CK) and an electrolytic condenser bank with a total

(*Continued on page* 1292)



Complete schematic wiring diagram of the six-tube, all-electric receiver and built-in power equipment described on this page.

A Simple "Extension" Two-Tube Receiver*

MANY persons seem to be of the opinion that the simple two- and three-tube receiving sets have gone out of style, and that practically everyone is now using an elaborate receiver employing from five to ten tubes; however, this is not the case. Correspondence which we receive from our readers proves, beyond a doubt, that there are just as many beginners today as there ever were; and a large number of these newcomers in the field are anxious to start with simple apparatus.

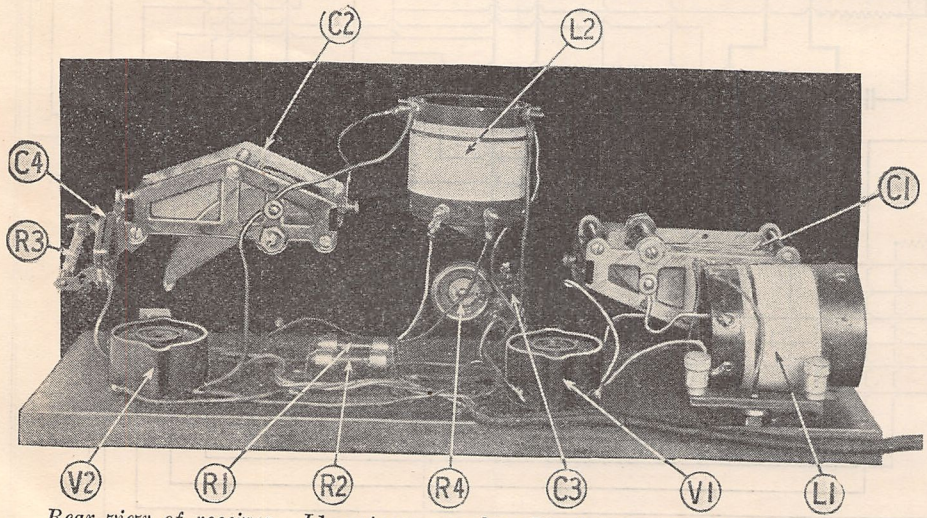
In connection with the frequent requests for data on the construction of simple receivers, it is interesting to note that the type of receiver desired is entirely different from the design which was popular several years ago. In the year 1923 many a broadcast fan, who contemplated the construction of a simple receiver, wished to obtain loud-speaker volume from one tube and was willing to sacrifice quality of reproduction, distance reception and selectivity in order to obtain this end. As a result there was a demand for designs of one-tube reflex receivers employing a crystal detector. At the outset the constructor understood, or should have done so, that the set would not be entirely satisfactory; but he was ready to spend his good time and money to build it in order to get the thrill of receiving broadcast music on a loud speaker.

Today conditions are very different. The beginner understands, first, that there are many stations on the air and a radio receiver must be selective enough to separate local stations, in order to assure him any degree of satisfaction from reception. Secondly, he knows that many worth-while programs are broadcast from high-power stations within a few hundred miles and, if his receiver is sufficiently sensitive, he can derive much satisfaction from picking up these signals. Thirdly, it has been explained to him that the most desirable feature of a radio set is its ability to reproduce music without appreciable distortion; and, in this connection, he is told also that volume of signal without distortion can be obtained only by using an efficient tuner in connection with a well-designed, high-quality audio-frequency amplifier with a power tube in the last stage.

FREE
Blueprints

TO facilitate the work of constructors, RADIO NEWS will give away, free, complete blueprints for sets described in the constructional articles that are printed in its pages, beginning with the April issue. (Blueprints of sets published previous to the April, 1928, issue *are not offered free.*)

Under the new policy of RADIO NEWS, no manufacturers' names nor trade marks are given in the text pages of RADIO NEWS. For the information of those who wish to construct sets and power packs, however, and to facilitate their work, the blueprints will contain complete specifications of all the material which is used in making the complete apparatus described in the constructional article. These blueprints will be given free to readers who apply in person at the office of RADIO NEWS, between the hours of 9:00 a. m. and 5:30 p. m., daily, and until 1:00 p. m. only, on Saturday afternoons. Those who apply by mail should enclose ten cents, for postage and mailing only. Address Blueprint Department, RADIO NEWS, 230 Fifth Avenue, New York City.



Rear view of receiver. L1, antenna coupler; L2, detector-circuit tuner; C1 and C2, variable condensers; R3, grid leak; C4, grid condenser; R4, volume control; C3, .006-mf. condenser.

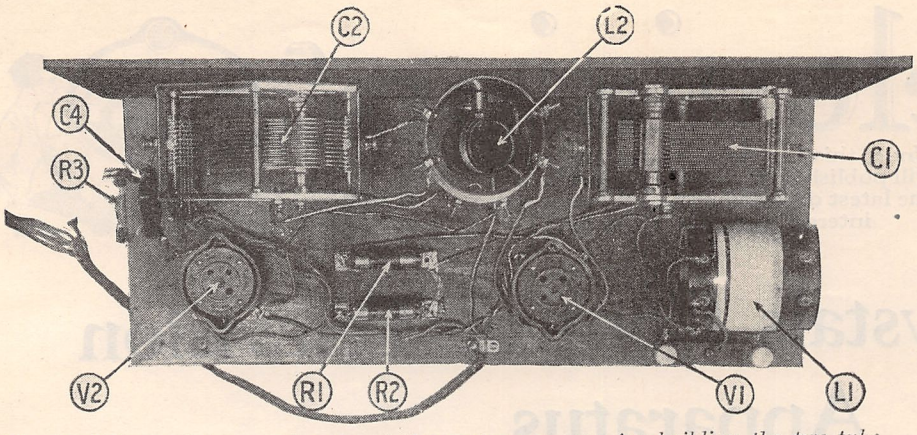
* RADIO NEWS *Blueprint Article, No. 53*

THE MINIMUM FOR GOOD RESULTS

As a result of the radio education which he receives by reading newspapers and magazines, and by hearing his friends talk over radio problems, the beginner no longer expects the impossible from a simple circuit. He appreciates the fact that freak circuits do not produce the results which are claimed for them, and most satisfactory results are assured by following a standard, accepted design. Also, he does not limit the set which he is to build to one tube, when he has learned from the experience of friends that at least two, and sometimes three, tubes are needed when satisfactory headphone reception is desired; *i.e.*, in order that the set shall be selective, sensitive and capable of quality reproduction.

In addition to the points considered above, the beginner, who builds a simple receiver wishes to construct it in such a manner as to permit improvements from time to time; and he desires a set which will compare favorably, when such additions have been completed, with the best receivers available. Above all things, he wants to know that his set can be conveniently enlarged so that it will deliver ample loud-speaker volume without distortion.

The receiver described in this article has been designed in the RADIO NEWS Laboratories to satisfy the requirements of the present-day radio beginner. It is a two-tube hook-up employing a well-known standard circuit, which consists of one stage of neutralized-radio-frequency amplification followed by a regenerative detector. When properly constructed, it will be found *equally sensitive and selective with the best of four- and five-tube receivers;* though it will not deliver the same amount of volume, simply because it is not equipped with an audio amplifier, which would require the addition of two or three extra tubes. However, it is readily possible to construct such an amplifier, and connect it to the receiver externally, at any future date, and this



The simplicity and inexpensiveness of the parts necessary for building the two-tube receiver is an advantage. The parts are lettered alike in the illustrations and the list on page 1285.

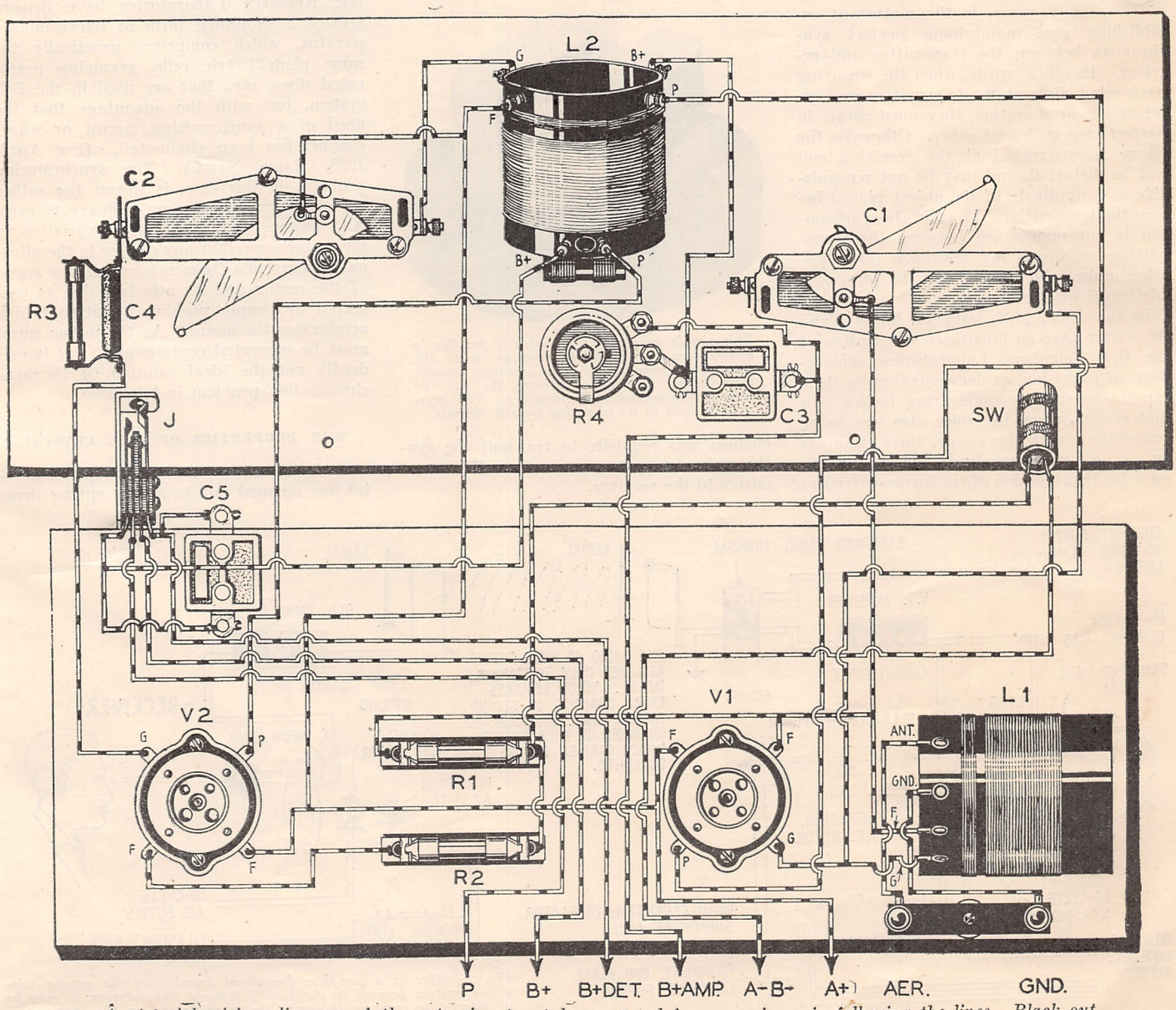
addition will make the receiver quite the equal of any four- or five-tube set so far as performance is concerned. In short, it is a *real* radio receiver which anyone may be proud to own, and must not be considered a joke, or old-fashioned in any sense of the word.

CONVENIENCE OF CONSTRUCTION

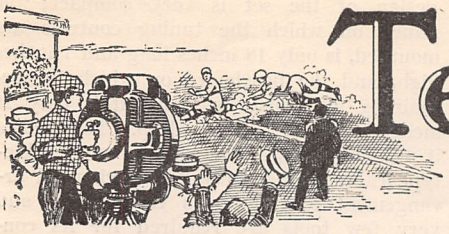
Aside from the electrical features of the set, there are many practical advantages possessed by the design. A glance at the pictures will show the prospective builder the features which should require no farther discussion. First, it will be seen that the design of the set is very compact; the panel, on which the tuning controls are mounted, is only 18 inches long and 7 inches high, and the baseboard on which the remaining apparatus is mounted is only 16 inches long and 7 inches deep. This makes it possible to place the set in a small table-type cabinet. Secondly, the mechanical arrangement of the set is very simple and very few tools are required for its construction. The tuning instruments are mounted on a bakelite or hard-rubber panel, but to mount the parts, it is necessary to drill through this panel. The baseboard is wood, ½-inch thick, and this makes it very easy to mount the other parts; as they may be fastened with ordinary wood screws. Of course, if the builder is mechanically inclined he may improve the appearance of the interior of the receiver by using a bakelite or hard-rubber sub-panel, and running all wires under this base. However, this is not necessary, as it would effect no improvement whatever in the electrical efficiency of the tuner.

When the receiver is constructed as shown, the wiring is very simple and also efficient. Flexible insulated wire is used and the "point-to-point" system is followed;

(*Continued on page* 1284)

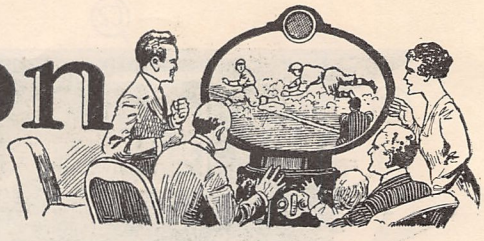


A pictorial wiring diagram of the extension two-tube receiver, showing all the necessary connections. At the top is the panel, and below the baseboard, shown separated for convenience in following the lines. Black out with a pencil each wire on the diagram as you connect it into the set; this will aid greatly in the wiring.

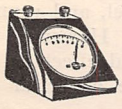


Television

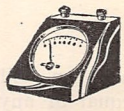
Under this new heading, RADIO NEWS will publish each month descriptions of the latest developments in the extremely interesting field of television.



Quartz Crystals Control Television Apparatus



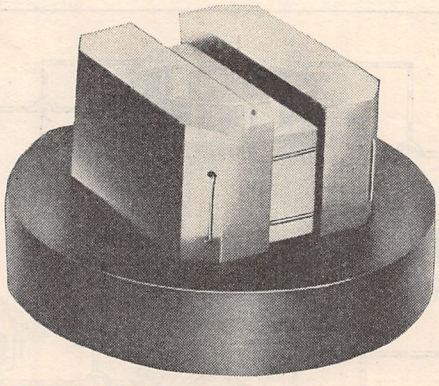
Synchronizing Circuit or Radio Channel Eliminated by Utilization of Quartz-Crystal Oscillators at Both Transmitter and Receiver



By H. Winfield Secor

ONE of the greatest, if not the greatest of the problems that have worried television experimenters for many years, is the matter of establishing and maintaining perfect synchronism between the transmitter and receiver. In other words, when the revolving perforated discs at the transmitter and receiver are in operation, they must rotate in *perfect step with each other.* Otherwise the image reconstructed at the receiving end will be distorted, and may be not recognizable as a duplicate of the object placed before the transmitter. If accurate synchronism is not maintained between the transmitting and receiving television discs, another undesirable effect takes the form of a "drifting" of the image.

In the June, 1927, issue of RADIO NEWS the writer gave an illustrated description of the Bell Telephone Laboratories' achievement of television, as demonstrated by their experts to various engineering bodies. In that system, when the voice also was to be transmitted with the image, three channels or circuits were required; the first being used for transmission of the image-currents; the second was necessary to carry the voice-currents; while a third circuit or wave-channel was requisite to transmit the synchronizing current or wave from the transmitter to the receiver.



This simple quartz crystal makes it possible to synchronize a television receiver with the transmitter from which it is receiving, though there is no connection between the two, or even synchronizing radio impulses. The crystal is held in its mounting by silk threads.

Recently, Dr. E. F. W. Alexanderson and his associate engineers of the General Electric Research Laboratories have demonstrated a simplified form of television apparatus, which comprises practically the same photoelectric cells, revolving perforated discs, etc., that are used in the Bell system, but with the advantage that the need of a synchronizing circuit or wave-channel has been eliminated. (See April, 1928, RADIO NEWS.) The synchronizing problem, in this case, is solved (or rather obviated) by utilizing an ordinary 60-cycle A.C. motor; and, whenever a variation in the motor's speed or any change in the alternating current's frequency occurs, the speed of the motor and its attached disc is corrected by simply pushing a button, which accelerates the motor. As the motor speed must be corrected continuously, this is evidently not the ideal solution of the synchronization problem in television.

THE PROPERTIES OF THE CRYSTAL

At last, however, the famous quartz crystal has stepped out in a new spring dress

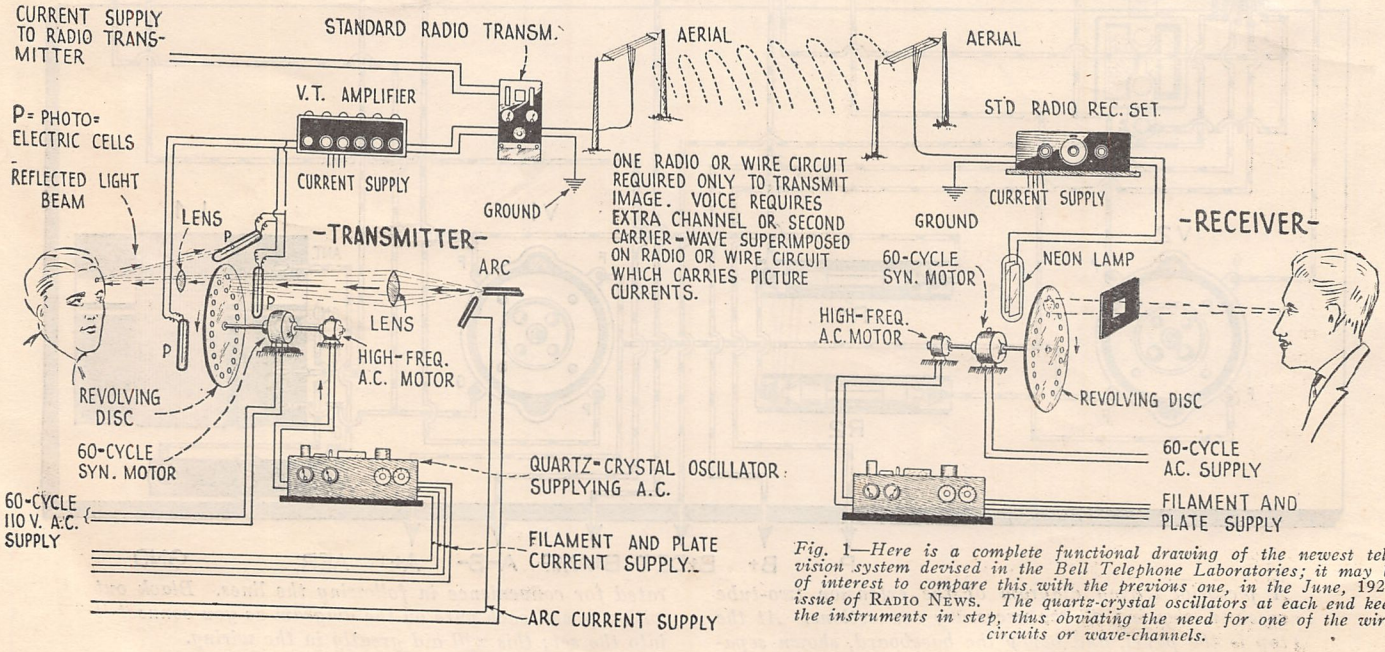
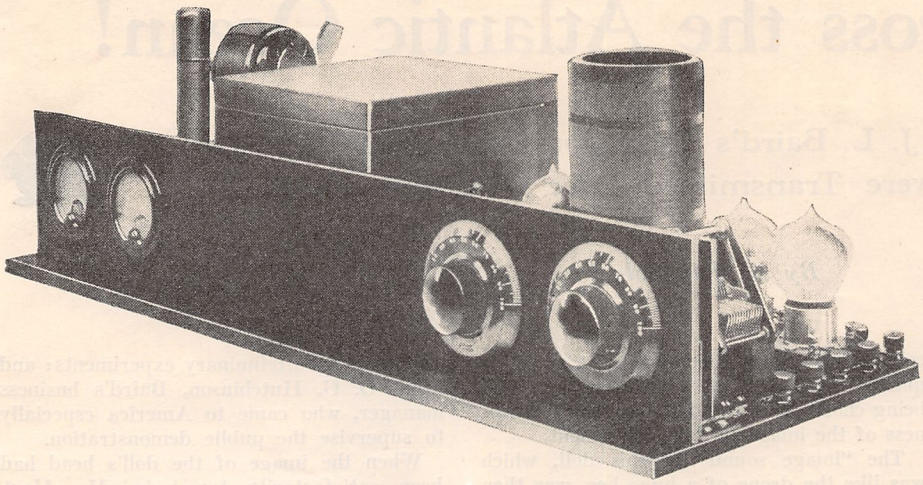


Fig. 1—Here is a complete functional drawing of the newest television system devised in the Bell Telephone Laboratories; it may be of interest to compare this with the previous one, in the June, 1927, issue of RADIO NEWS. *The quartz-crystal oscillators at each end keep the instruments in step, thus obviating the need for one of the wire-circuits or wave-channels.*



The appearance of one of the quartz-crystal oscillators indicated in the drawing on the opposite page; the crystal is enclosed in the large box, with apparatus keeping it at a uniform temperature.

and hat, so to speak, and has bestowed a priceless boon on the television engineers, by solving the bugaboo over which they had spent so many sleepless nights. Their endeavor to simplify and eventually commercialize the "seeing over a wire" idea, first demonstrated last summer, has been facilitated by putting the crystal to work at keeping the discs revolving with *exactly the same speed at both transmitter and receiver.* This is accomplished by the use of a quartz-crystal-controlled oscillator and a two-stage amplifier at both ends of the line.

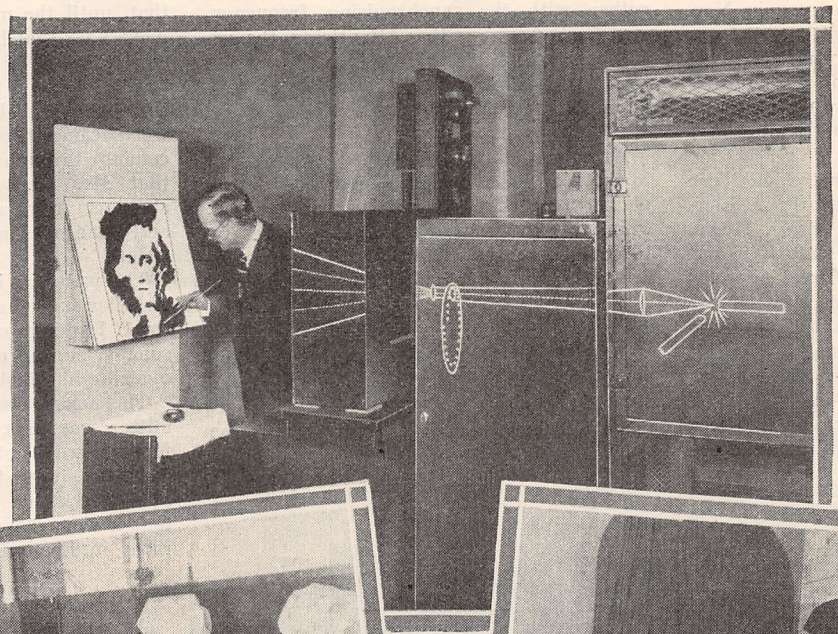
It is a peculiar property of quartz and some other crystals, and an extremely valuable one, to have fundamental frequencies at which each responds to electrical vibrations. The effect is called *"piezo-electric"*: the molecules of a crystal acquire, apparently, an electric charge when the crystal is twisted or pressed out of shape, without breaking it. It would seem as if the internal arrangement of a crystal is in some ways like that of a magnet. The difference between magnetized and unmagnetized metal is that, in the former, all the particles are turned with their magnetic poles in the same direction. So, also, when a crystal is twisted, the arrangement of its internal particles is disturbed, and there is a re-adjustment of their electrical charges, causing the appearance of a difference in voltage between one side of the crystal and the other.

So also, when we apply a difference of potential, or a voltage, across a crystal we cause a disturbance, of the arrangement of the crystal's particles, which slightly deforms the crystal. When we cause this volt-

(*Continued on page* 1281)

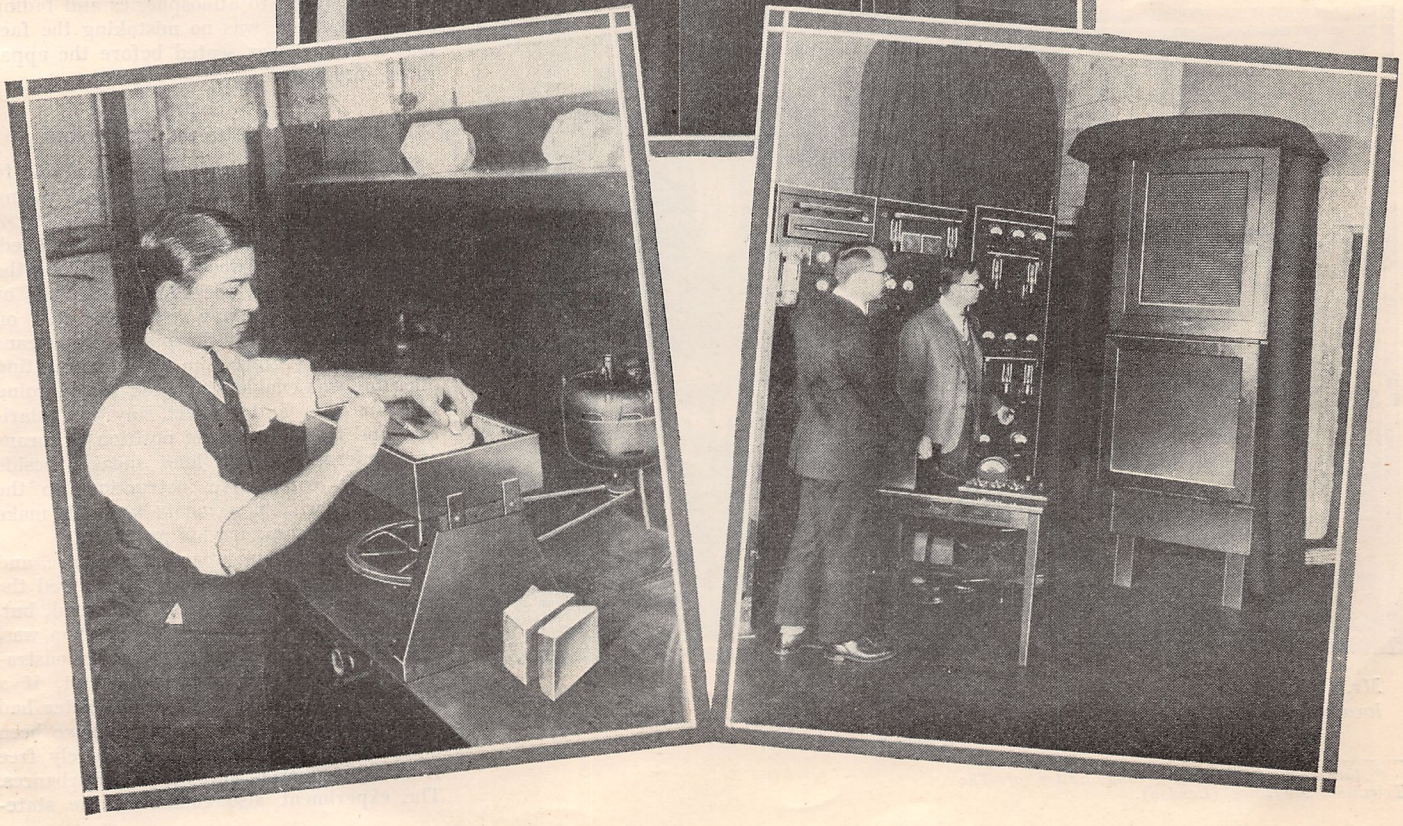
At the right, the television transmitter, with its "scanning" mechanism indicated in "phantom." The artist, Charles Bittinger, and the portrait he is drawing, are thus recorded with motion-picture frequency. The metal cabinet behind Mr. Bittinger contains the photo-electric cells.

Below, the process of grinding the quartz crystal to the exact thickness required. This is a very delicate operation, which may be compared with work on a lens. The thickness of the crystal regulates its frequency.



Light for the television transmitter is provided by an arc lamp, indicated at the right of the center picture; it sweeps over the moving objects in a small, brilliant spot, the strength of whose reflection governs the strength of the transmitted impulse corresponding to its position at each instant.

Below, the newest television receiver, with the improved luminous screen, explained on page 1282; *below which appears the cloth-covered opening of an exponential-horn speaker. The amplifiers and controls are on the panels at the left.*



Seeing Across the Atlantic Ocean!

A Description of J. L. Baird's Television Experiments, During Which Images were Transmitted Over 3000 Miles by Radio

By A. Dinsdale **

IT is less than a year since the American Telephone & Telegraph Co. successfully demonstrated television between Washington and New York, using ordinary telephone lines as the medium of transmission over a distance over 200 miles.

Shortly after that demonstration, John L. Baird, the British inventor of television, gave a successful exhibition of his apparatus between London and Glasgow, a distance of 435 miles. This distance held the record until the begining of this year, when Baird himself shattered it by transmitting television right across the Atlantic!

Just what does this mean? It means that recognizable images of human beings seated in the heart of London were seen in New York, over 3,500 miles away!

This public demonstration, which was carried out in the early hours of the morning of February 9 (London time), turns out to be the culmination of months of secret experimenting.

On the night of the demonstration there assembled at the Baird laboratories in London a small party made up of Mr. Howe, the Associated Press representative, and Mrs. Howe, Mr. W. Fox, the Press Association representative, the writer, and one or two other privileged guests. The transmissions commenced at midnight, London time, or 7 p. m., February 8, New York time.

In order to give the watchers at the New York end an opportunity to adjust the receiving apparatus, the image of a ventriloquist's doll was first transmitted; a doll being chosen because of the need for steadiness of the image during adjustment.

The "image sound" of this doll, which was like the drone of a huge bee, was then sent over a telephone line to Baird's private experimental radio station at Coulsdon, Surrey, a few miles out of London. The station has a power of only 2 kw., and operates under the call letters 2KZ, on a wavelength of 45 meters. No doubt many readers have heard the transmissions of this station during tests, and wondered what the droning noise meant.

From this station the image sound, together with the synchronising frequency, was flashed across the Atlantic to the receiving station at Hartsdale, N. Y., which was placed at Baird's disposal by courtesy of the owner and operator, Robert Hart (2CVJ).

After amplification the signal was applied to the receiving televisor, upon the ground-glass screen of which the image appeared. This screen measured about two inches by three inches; the entire televisor occupies no more space than an average suitcase.

"AND THERE SHALL BE NO MORE SEA"

Four watchers were anxiously gathered round the apparatus. These included the Reuter's Press representative; Mr. Hart; Mr. Clapp, one of Baird's assistants, who has been in America for some months in charge of the preliminary experiments; and Capt. O. G. Hutchinson, Baird's business manager, who came to America especially to supervise the public demonstration.

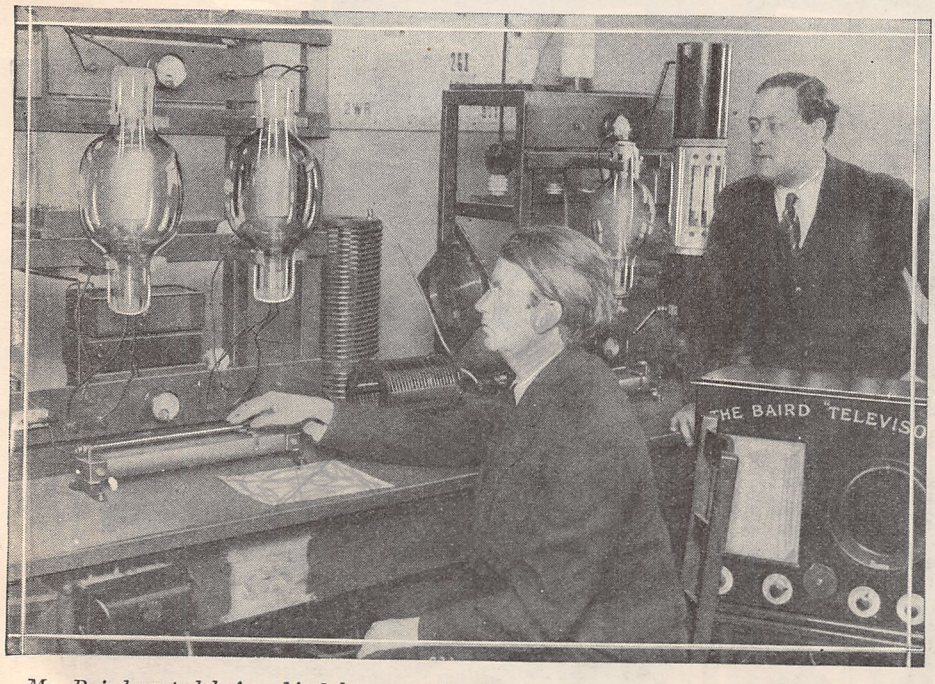
When the image of the doll's head had been satisfactorily tuned in, Mr. Hart started up his short-wave (amateur) transmitter and called Baird's receiving station at Purley, near London. Using the Morse code, Mr. Hart asked that, instead of the doll, Mr. Baird should take his place before the transmitter. This message was telephoned from Purley to the transmitting laboratory in London.

For half an hour Mr. Baird sat before the transmitter, moving his head this way and that, until the message came through from New York that his image had come through clearly.

Mr. Fox then took Mr. Baird's place, and continued to sit before the transmitter, until word came through that his image was coming through excellently. It appeared that Mr. Fox's features are particularly striking, from a television point of view, and transmit better than those of other sitters.

The watchers in New York did not know "who" was going to be "transmitted"; but Capt. Hutchinson, who knew Mr. Fox personally, had no difficulty whatsoever in recognizing him instantly.

The next person to sit before the transmitter was Mrs. Howe, and, although her features were not recognizable at the American end, owing to atmospherics and fading of signals, there was no mistaking the fact that a woman was seated before the apparatus in London.



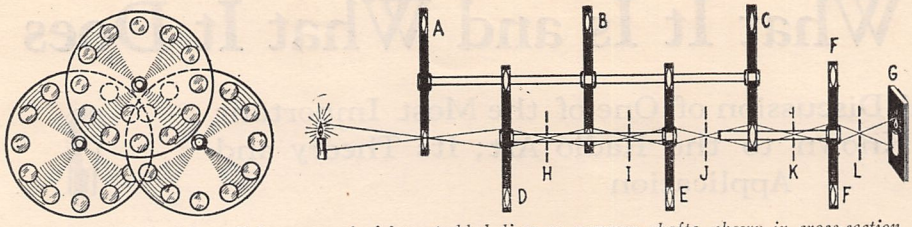
Mr. Baird seated before his 2-kw. experimental short-wave transmitter, 2KZ, which is located at Coulsdon, a few miles from London. Mr. Clapp, an assistant, is behind the television receiver.

CHECKING THE TRANSMISSION

Those assembled in London were able to see, on a "check" receiver, corresponding to the "monitor" of sound broadcasts, *a pilot image* of what was being transmitted. This image, which was full-size, showed the head of the sitter, the complete details of the features appearing in black relief on an orange-colored background. By means of this pilot before him, the transmitting operator was enabled to check the outgoing transmissions and correct any irregularities, and from his control position by means of a microphone and loud speaker beside the sitter, could give instructions to the latter as to what movements he should make to keep in focus, turn his profile, etc.

Atmospherics and other interference, and also fading of signals, at times marred the image received at the New York end, but, in spite of these disabilities, reception was, on the whole, very good. The demonstration proved quite conclusively that, if a much more powerful radio transmitter had been employed, the image could have been received in New York almost entirely free from atmospherics and other disturbances. The experiment also confirmed the state-

* *Author of "Television," and Editor of The Television Magazine (London).*



The Baird "Optical Lever" is composed of lens-studded discs on common shafts, shown in cross-section at the right, and in end-view at the left. The illuminated image cast through A is moving at an apparent speed which is doubled by the lens in D, and so on to any desired rapidity of horizontal "scanning." The focal points of the lenses are represented at H, I, J, K, L. The disc F causes the transmitted image to move perpendicularly back and forth across the window of the photoelectric cell G. (British patent 265,640.)

ment which Baird has frequently made, to the effect that the distance spanned is merely a matter of power, and that it has no dependence upon any development of the television apparatus itself.

SMALL STAFF NEEDED

In contrast to the A. T. & T. demonstration, which required the services of over 200 men, Baird's transatlantic demonstration required the services of but two operators to manage the television transmission, one at each end of the circuit. All told, the total number of persons employed did not exceed eight: one to control the transmitting televisor, one standing by the telephone to keep in touch with the transmitting station at Coulsdon, one standing by the telephone connecting the laboratories with the receiving station at Purley, two operators at the Coulsdon station, one at the Purley station, one at Hartsdale to run the American radio station, and one to run the receiving televisor.

The design of the television transmitter used for the demonstration closely adheres to that already described in these pages (See Radio News for September, 1926, June, 1927, and January, 1928) by the present writer. Briefly described, this consists of an image-exploring mechanism composed of three rotating discs, one of them carrying a number of lenses set in "staggered" formation near its outer edge; while the other two are simply slotted "interrupter" discs, set so that they overlap one another, and move in opposite directions at the point of overlap.

Considerable improvements have been made in the construction of this apparatus. It has been considerably enlarged, and a more perfect engineering job has been made of it; so that it runs much more smoothly, and is capable of handling a much larger image. Improvements have been made in the light-sensitive cell too, so that much less intense lighting is necessary. The sitters at the recent demonstration were bathed in flood lighting no more powerful than that employed in a photographer's studio.

LATEST DESIGN OF MECHANISM

In another part of his laboratory, however, Mr. Baird has erected another and more modern machine, which is at present undergoing test. This new machine makes use of the principles involved in one of Baird's latest master patents, called the "optical lever." Briefly outlined, the object of the optical lever is to increase the speed of an image passing across the light-sensitive cell, without increasing the speed of rotation of mechanical parts.

This object is achieved by mounting, on two parallel shafts, two sets of lens discs. The first pair of discs, at the end of the shaft, overlap one another and move in opposite directions at the point of overlap. The distance between the two discs is so arranged, however, that they overlap at a point where their focal points coincide.

Further along the shafts other pairs of discs can be added, and the principle of the arrangement is such that, for every extra pair of discs, a doubling of the speed of the image is obtained.

There is no limit to the number of discs which may be added, by suitably lengthening the parallel shafts, so that there is virtually no limit to the number of image, or light impulses, which may be flashed per second upon the light-sensitive cell; and this phenomenal result is achieved without in any way speeding up the mechanism, which may rotate at any speed at all which may be prescribed by good engineering practice for the weight of revolving material concerned.

The speed difficulty in television is thus no longer limited by mechanical considerations, nor is it limited by the light-sensitive cell. The limitation now rests with the transmitting medium, which, whether it be wire or radio, will transmit only a certain definitely-limited number of impulses per second, according to the characteristics of the circuit. The only solution to this problem would appear to lie in the use of multiple light-sensitive cells and multiple transmission channels; concerning methods for the accomplishment of which Baird already has a number of patents.

LARGER IMAGES DEMANDED

The need for increasing the capacity of the entire system, *i.e.*, increasing the number of impulses per second which it can handle, becomes evident when it is desired to increase the size of the transmitted image. At present Baird transmits an image of the size of a human head only, and does so with a wealth of detail and "half-tone." This necessitates the transmission each second of a certain number of impulses which is well within the carrying capacity of an ordinary telephone line. But, in order to transmit two human heads simultaneously, with the same amount of detail, it would be necessary to transmit twice as many impulses per second.

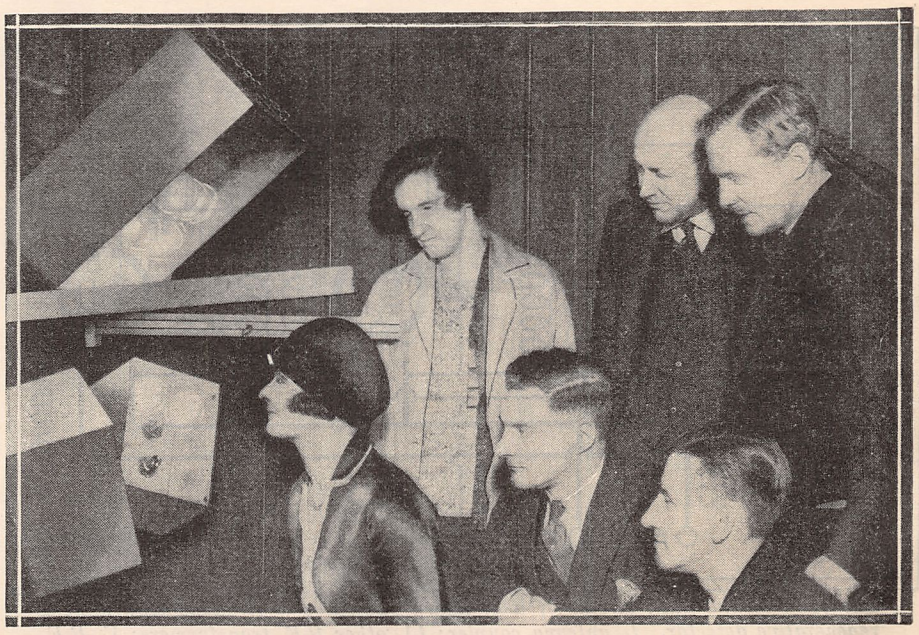
This and many other problems in connection with television still await solution before we may expect to sit and watch, on a screen the size of the standard for moving-pictures, the full details of, say, the annual Army-Navy ball game. There is an unlimited field here for the experimenter.

Before concluding this article it is worthy of note that the amateur radio operator has contributed very considerably to the success of Mr. Baird's transatlantic television transmissions. By virtue of the great strides he has made in the development of long-distance short-wave communication by means of very low power it has been made possible to stage such a spectacular demonstration at comparatively little expense. Furthermore, it could have been done only on short waves; for it is not possible to charge up satisfactorily the enormous tuned antenna of a high-power long-wave radio station at the very high speed of signalling required in television.

TELEVISION AT SEA

Since this description of the first transatlantic radiovision experiments was put in type, a further demonstration has been made on the liner *Berengaria;* aboard which, a thousand miles at sea, a television image was received by radio on March 7.

The *Berengaria's* chief radio operator, Stanley Brown, was thus specially favored with the opportunity to see his fiancée, Miss Dora Selvy, who posed before the transmitter at the Baird Laboratories in London, and who was at once recognized by him. The demonstration was arranged by Capt. Hutchinson, then returning to England after conducting the reception arrangements above described for the transatlantic test.



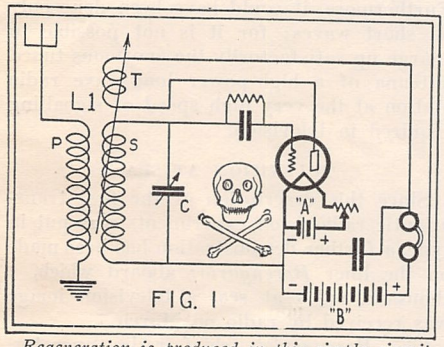
Mrs. Howe (with hat) seated before the television pick-up, being "televised" across the Atlantic. Immediately behind her is seated the author. Note the banks of lights for illuminating the subject's face.

Regeneration — What It Is and What It Does

A Semi-Technical Discussion of One of the Most Important Circuit Actions Known to the Radio Art; Its Theory and Application

By Fred H. Canfield

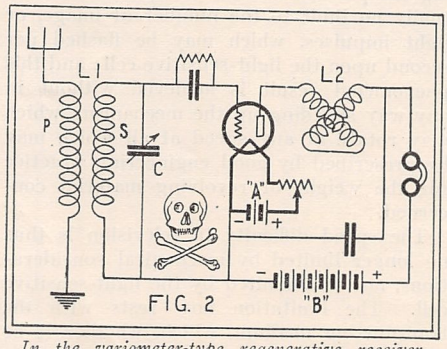
THE designer of the radio-frequency circuits of a broadcast receiver finds that the problem of regeneration is one which he must always take under the most careful consideration; whether he desires to utilize this phenomenon or to suppress it does not affect the fact that it must be reckoned with. In some instances regeneration is employed to give additional amplification in the stages affected; in others the attempt is made to gain stability of operation by eliminating, as far as possible, the effects of the regeneration which exists, to some extent at least, in practically all R.F. tube circuits. But, in any event,



Regeneration is produced in this simple circuit by feed-back from the tickler (T) to the secondary (S). As a broadcast receiver, it is poison to nearby listeners.

to keep regeneration under positive control is the aim of every radio engineer.

It is difficult to say whether regeneration is one of the most desirable or most undesirable characteristics of vacuum tube circuits; for, when rightly employed, it is a great aid, but, when undesired, it is a great annoyance. With a circuit in which regeneration is used properly, it is possible to obtain an amplification of as high as 25, which is approximately three times as great as may be obtained from an R.F. stage without regeneration. On the other hand, the existence of regeneration increases the selectivity of a circuit, and in some cases it causes the set to tune so sharp that the sidebands of a wave are excluded, resulting in badly-distorted reception. The ideal



In the variometer-type regenerative receiver, feed-back takes place through the capacity between the plate and grid elements of the tube. It is deservedly obsolete.

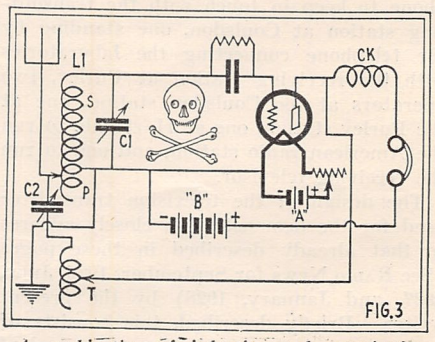
solution to the problem would be to develop a system which would provide exactly the desired amount of regeneration on all wavelengths; but an entirely satisfactory means for obtaining this condition has not yet been discovered.

It is necessary, in order to understand the theory of regeneration in radio circuits, to have first a general understanding of the way in which vacuum tubes function in amplifying circuits. The reader will find it helpful to refer to "The Radio Beginner" in last month's Radio News (page 1124), as this department contains much elementary information on the subject of simple radio circuits. However, a brief summary of the facts will be given in the next paragraph.

THE VACUUM TUBE

The ordinary vacuum tube used in radio comprises three electrical "elements"—filament, plate and grid—together with the fine wires or "leads" which run from them to the prongs set in the tube base, by which contact is made to the rest of the apparatus in a receiver.

The filament, in the center of the tube, is a thin wire of special composition, which



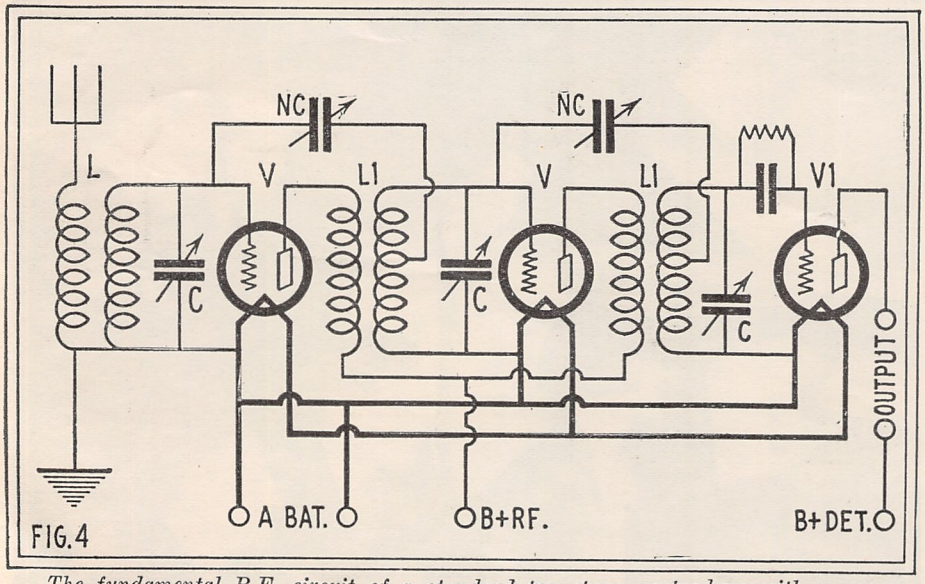
A combination of inductive and capacitative feed-back is used to produce regeneration in the Reinartz circuit, shown above. Suitable only for short-wave work.

is heated to "incandescence" or nearly so by the "A" battery, which is often a storage battery, or by special devices furnishing a low voltage.

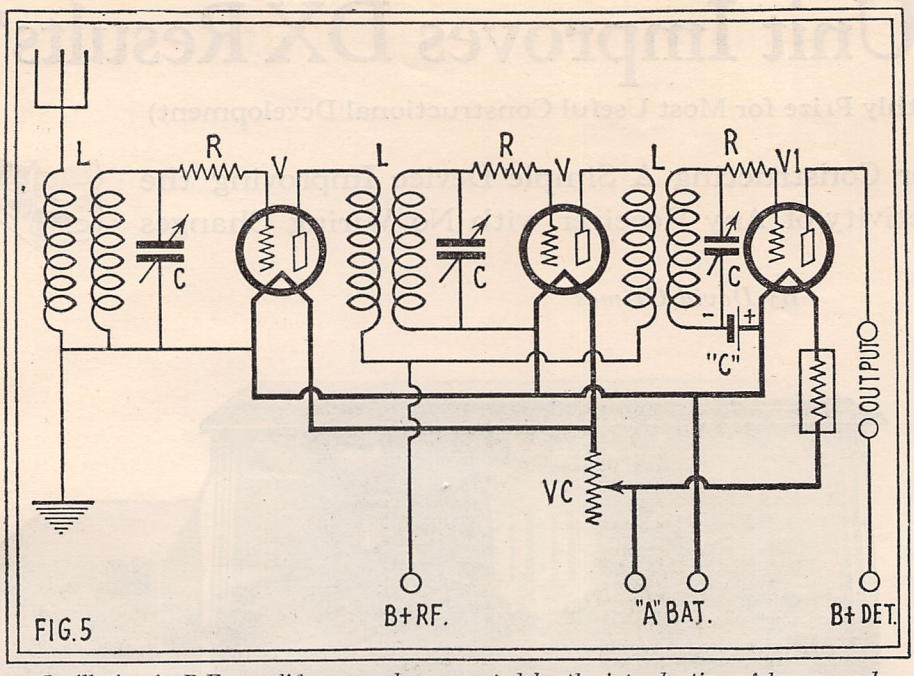
The plate, which is nearest the bulb of the tube, is usually in the form of a thin metal cylinder surrounding the filament; between the outside wires connecting to their leads is applied the voltage from a "B" battery or power unit, with the "B+" terminal attached to the plate lead.

The grid is a coil or screen of very fine wires, close together, which is placed in the space between the filament and the plate, inside the tube. Upon the *voltage* which is applied to the grid depends the action of the tube, other things being equal.

When the filament is heated it gives off electrons; these are attracted by the positive charge on the plate, and there results a flow between these elements of "plate current." When the voltage on the grid (as measured from the filament) is zero, the flow of current reaches a certain value determined by the plate voltage and the "characteristic" of the tube; when the grid voltage is negative, the plate current decreases, and when the grid voltage is positive, the plate current increases up to a certain limit. It requires a very small change of voltage (and almost inconceivably little current) to cause considerable changes in the plate current, and it is this fact which enables the use of a vacuum tube as a volt-



The fundamental R.F. circuit of a standard two-stage neutrodyne with a non-regenerative detector. L, antenna coupler; L1, other R.F. transformers; V, R.F. amplifier tubes; V1, detector tube; C, tuning condensers; NC, neutralizing condensers, which are small in capacity, to offset the tube capacities.



Oscillation in R.F. amplifiers may be prevented by the introduction of losses; and in this circuit fixed-resistor units are used for the purpose. L, R.F. transformers; C, tuning condensers; V, R.F. tubes; V1, detector tube; VC, volume control.

age amplifier. In the case of the standard 201A-type tube the amplification factor under correct operating conditions is approximately 8; and, therefore, if the incoming oscillations cause the grid voltage or "potential" to "swing" 2 volts, the variations in the plate circuit will be eight times as great, or 16 volts.

THE "FEED-BACK"

In a *regenerative* circuit, the voltage variations of the grid affect the plate current exactly as they do in the usual amplifier; but the effect of voltage changes produced by the varying current in the plate circuit is returned to the grid circuit. This action is called *"feed-back."* As the voltage changes in the plate circuit are *"in phase"* with those in the grid circuit, the grid-voltage variations are increased by feed-back from the plate circuit, and in this way the amplification of the tube is greatly increased. The amount of extra amplification which may be obtained in this way is determined by two factors; first, the amount of plate-current energy which is returned to the grid circuit; and second, by the *"critical point," at which the tube enters a state of self-sustained oscillation.*

From the above description it is easy to see that the amplification of the circuit increases as the transfer of energy from the plate circuit to the grid circuit is increased; for, regardless of how much energy is returned to the grid circuit, this energy is again amplified by the tube with the result that the plate-current variations are increased—that is if the tube does not start "oscillating. However, the point which is difficult for the beginner to understand is that the entire operation described above takes place almost instantaneously and, as a result, under normal conditions has no effect upon the signal which is being amplified. On the other hand, when one endeavors to obtain too much amplification through regeneration the signal is *distorted;* but this will be discussed at greater length in another paragraph.

In order to explain the effect which regeneration has upon a circuit many authorities use the term "negative resistance"; *i.e.,* they say that introducing regeneration into a circuit has an effect similar to reducing the resistance of the circuit. In many ways this explanation is very satisfactory; but it has often caused experimenters to believe that the resistance in regenerative circuits need not be considered, because it may be decreased by increasing the amount of regeneration. However, this belief is not true. Theoretically, however, when the tube breaks into a state of "oscillation," the positive (actual) resistance of the circuit has been reduced to zero by the "negative resistance."

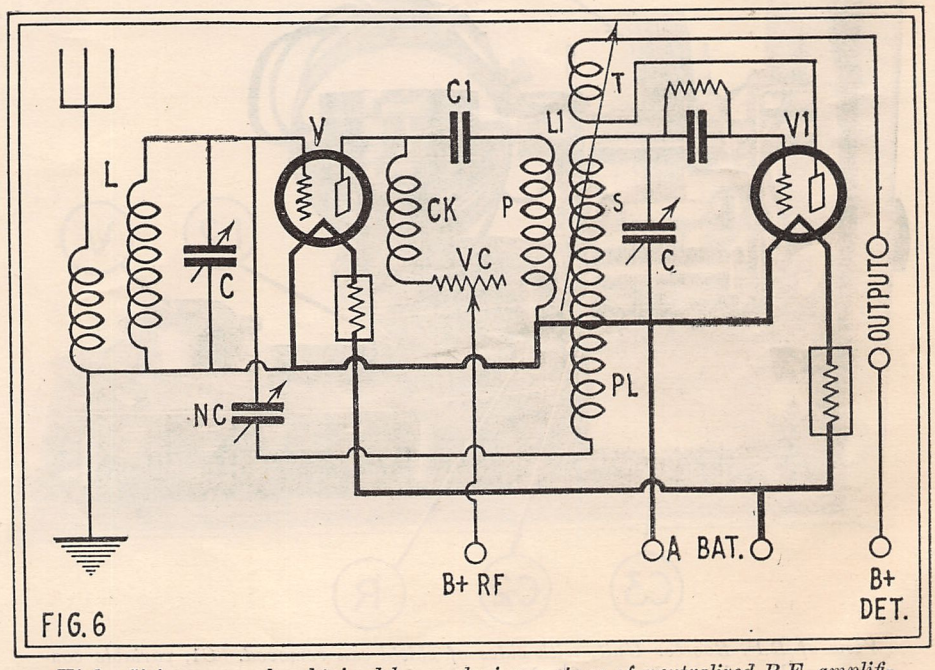
EFFECT OF OSCILLATION

Regeneration not only produces the effect of reducing the resistance of the circuit by increasing the strength of the signals, but also greatly increases the *selectivity* of the circuit. When regeneration is not present, the receiver may tune so broad that it is impossible to receive stations without interference; but, as the regeneration is increased, it will be found that the selectivity is ample for all usual requirements. Also, when the detector tube is operated on the verge of oscillation, the selectivity is often so extreme that music is badly distorted because the *"sidebands"* of the wave are excluded, thus cutting off the higher notes. Under these conditions the harmony will be supplanted by rough blasting tones, while the volume of the signal is often much greater than when the musical tone is preserved. After the tube enters a state of oscillation, the volume of the signal is usually greatly reduced, but the distortion remains. Music received when the detector tube is oscillating often sounds like escaping steam and is accompanied by whistling sounds.

Before continuing with the discussion on regeneration, the wiring diagram of a regenerative receiver will be considered. Fig. 1 shows the circuit of a simple "three-circuit tuner" (more properly "two-circuit") in schematic form; this represents what was once one of the simplest, most popular and most frequently-used receivers. It is easy to operate, as there are only two tuning controls, and it provides amplification which is practically equal to that of a two-stage tuned R.F. receiver with a non-regenerative detector. Of course, the overpowering disadvantage of this system of reception is that, when it is not properly operated, it will oscillate and the radiated energy from the antenna will interfere with reception in nearby receiving sets. For that reason, operation of an oscillating regenerative set is in some places punishable by law; and might be in this country under the Radio Act.

Although this circuit is no longer in general use as a first stage of broadcast reception, its operation will be considered, as it is a basic regenerative circuit and is often employed to advantage when placed after one or more stages of tuned R.F. amplifi-

(*Continued on page* 1288)



High efficiency may be obtained by employing a stage of neutralized R.F. amplification, followed by a regenerative detector. L, antenna coupler; L1, detector-circuit coupler; V, R.F. tube; V1, detector tube; C, tuning condensers; VC, volume control. (*See also page* 1285, *of this issue*).

R. F. Booster Unit Improves DX Results*

(Awarded $100.00 Monthly Prize for Most Useful Constructional Development)

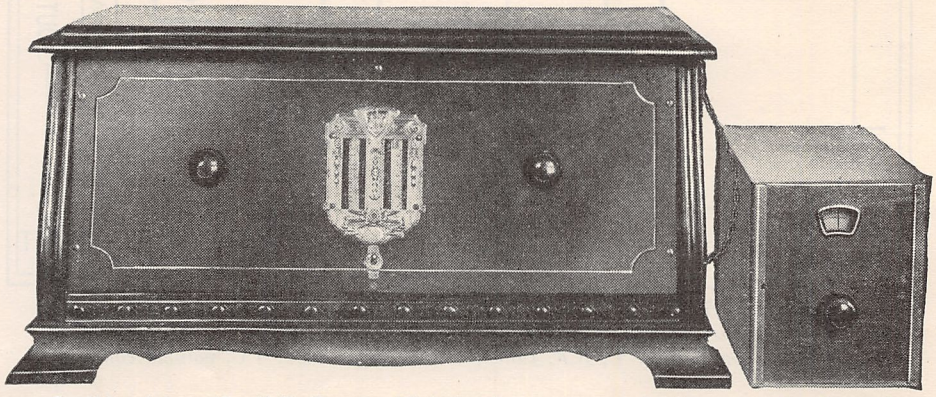
Complete Details for Constructing A Simple Device Improving the Sensitivity and Selectivity of Any Receiver with No Wiring Changes

By David Grimes

THE greatest thrill of radio always has been, as it always will be, the reception of broadcast programs from remote transmitters. In the earliest days of radio broadcasting, the experimenter desired above all to have as comprehensive a log as possible, and local stations were little esteemed. Notwithstanding all the efforts to the contrary which have been made by manufacturers and broadcasters, that desire for distance still remains with every true radio fan.

It is well known, of course, that distant reception has been made extremely difficult in the past two years, first, by the excessive number of stations which "jam" every available broadcast channel; and, secondly, by the tendency toward the production of single-control receivers, which too often involves a sacrifice of real receiving efficiency for the sake of simplicity in operation.

The owner of the old, but efficient, three-dial receiver is now seeking relief from the congested condition of the ether; while the single-dial owner has fully realized as well the inherent shortcomings of his particular instrument. It is, further, universally understood that governmental relief, because of the many technical and legal difficulties, is not to be expected in the immediate future; but the entire situation calls for some remedy at once.



In this picture the R.F. Booster Unit is shown connected with a standard tuned R.F. receiver. In order to install the Booster Unit it is only necessary to insert a plug in the detector socket.

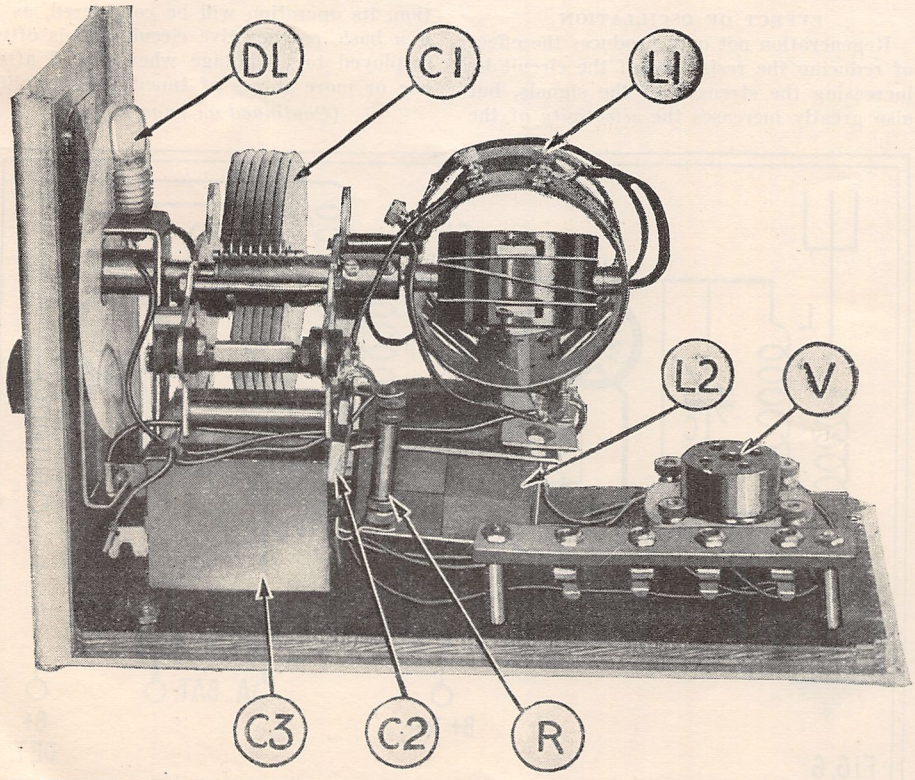
Many radio laboratories have been working diligently to perfect apparatus suitable to cope with present conditions, and some devices have already been offered to the public; but these are, in most instances, limited in their application to some particular receiver or some special location. With all of these facts in mind, the writer has conducted extensive tests in the hope that some simple attachment could be designed for universal use with present sets.

An excellent solution of the problem, he is confident, has been found, and it is here presented for the first time, exclusively to the readers of Radio News. Its fundamental principle is a development of a new circuit whose peculiarities and unusual results have been under observation for over a year in his laboratory. Some of its interesting phases became generally known last fall; but each succeeding week of experiment has unfolded additional possibilities and, only recently, came the realization that the R. F. "Booster Unit" holds a universal answer for the problem of improving the receivers in present use.

The attachment has been worked out in such a way that it is necessary merely to plug it into the detector-tube socket of a set, without making other connections of any kind. *No changes of any kind are necessary in the set itself.* In this way, the device may at any time be put instantly into service, and as quickly removed from the receiver. This permits the making of an intelligent comparison, and the marked improvement will demonstrate that the small cost of construction is more than warranted by the results. Every part of the receiver is utilized without change—the R.F., detector and A.F. circuits.

The "plug-in" unit constitutes a genuine addition to the set and is in no sense a replacement. The tuning of the receiver is not changed; it is merely made sharper. There is, therefore, no need of re-logging the set except to record the new stations which will be heard after the unit has been attached.

Reference is made here to Fig. 2 which shows the functional rearrangement of a standard five-tube tuned-radio-frequency re-



View of R.F. Booster Unit, with sides of shield-can removed. C1, variable condenser; C2, grid condenser; C3, by-pass condenser; L1, Coupler unit; L2, audio choke coil; R, grid leak; V, tube socket; DL, dial light.

* Radio News *Blueprint Article No. 54.*

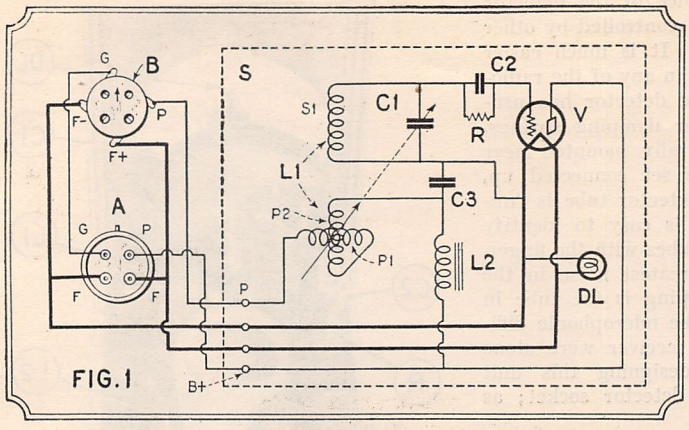
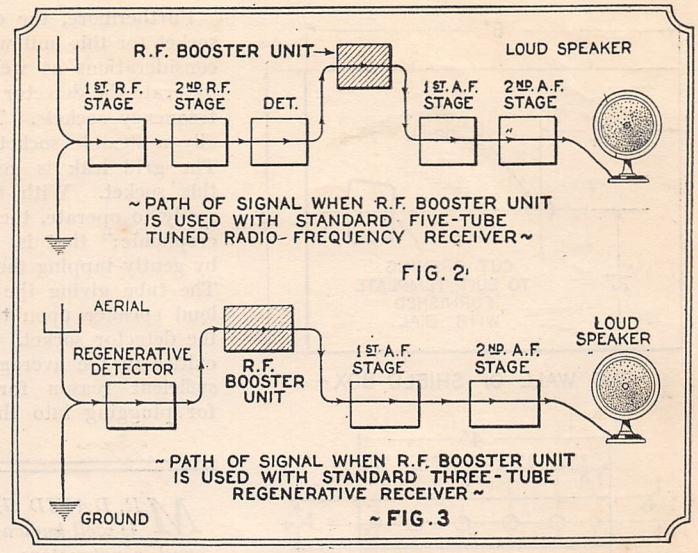


Fig. 1—Complete schematic wiring diagram of the R.F. Booster Unit described in this article. The symbols correspond to those used in the text and other illustrations. Figs. 2 and 3 indicate the location of the Unit in two types of sets.



ceiver. The unit is connected in immediately after the detector stage and immediately ahead of the first audio stage. Fig. 3 shows the comparative arrangement for a three-tube regenerative receiver. It will be noted that the "Booster Unit" is connected following the detector in the regenerative set, and the tickler coil then operates in the plate circuit of the booster stage, where it is quite as effective in its operation as it was previously. Fig. 4 is a schematic wiring diagram of the unit and the associated circuits just ahead and just after its position in the tuned radio frequency circuit. The unit wiring is shown within the dotted lines which indicate shielding; while the remaining wiring belongs to the associated circuits. Fig. 5 shows the schematic wiring diagram when the unit is connected into the regenerative circuit.

Now the theoretical considerations in this circuit are most interesting. At first glance, it appears that a second detector has been added to the circuit—and so it has! The detector circuit, ordinarily used in the receiver for the production of the audio frequencies, no longer serves this purpose; but the "by-products" or secondary functions of the detector, ordinarily wasted, are retained and utilized in this new circuit for the increase of selectivity and distance.

RADIO-FREQUENCY COMPONENTS

In order to appreciate fully the electrical actions taking place, one must recall that the plate circuit of a detector tube contains, not only audio-frequency currents, but also radio-frequency currents of half the wavelength ("harmonics")! These are the frequencies which are brought into play upon the installation of the R.F. booster unit. So the circuit that was formerly the detector circuit becomes a radio-frequency stage and the new unit operates as a detector.

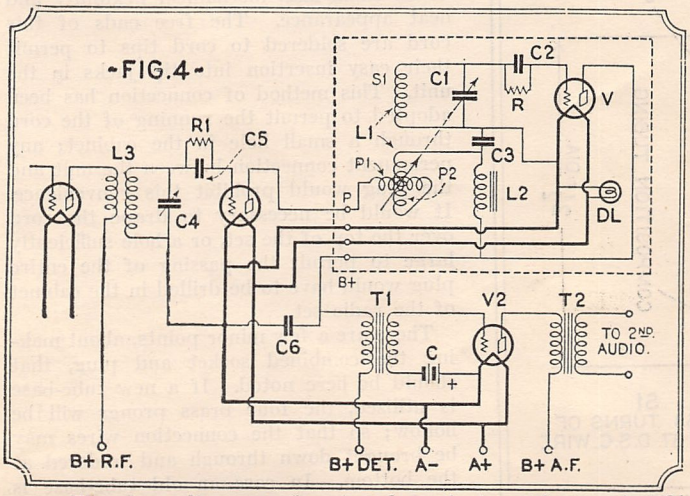
The "Booster Unit" may be used in either one of two ways: in the first, the unit operates on the original wavelength of the signal and under these conditions the detector tube functions exactly as an additional stage of tuned R.F. amplification. In the second, the Booster Unit operates on the "half-wave" or "second harmonic" of the signal, and then the detector acts as a frequency-changing circuit. Different results are obtained when the unit is used in these ways; in the first, both the sensitivity and the selectivity of the receiver are generally improved while, in the second, the selectivity is greatly improved but the sensitivity is slightly impaired. The standard unit described in these pages operates on the original wavelength of the signal; but elsewhere in this article will be found directions for making a boøster unit which operates on the half-wave. Both types are satisfactory; but they accomplish different results.

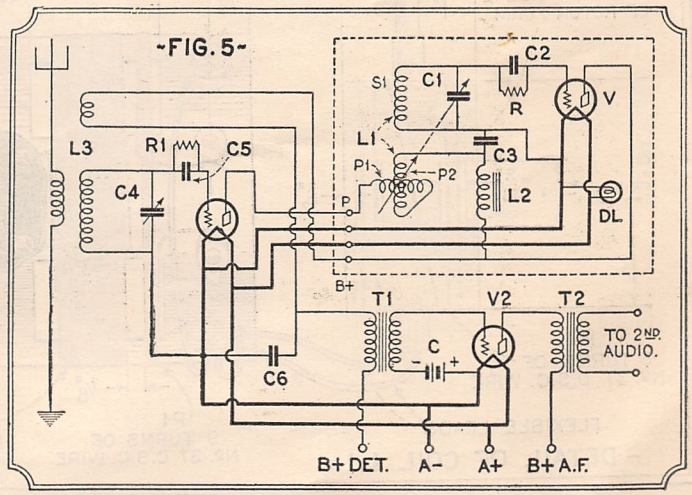
The above description will cover that application of the Booster Unit which makes the detector stage an additional stage of radio-frequency amplification. A unit of this type will considerably increase the distant pick-up of the receiver and will also

NEW!

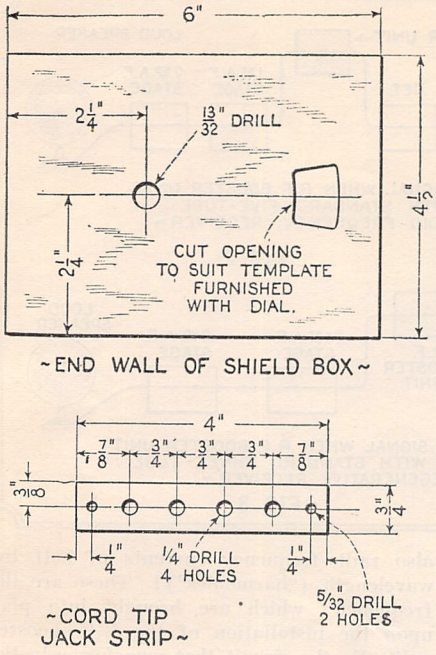
MANY listeners have long been looking for a device of some kind which might be connected to a receiver of any type to give the increased sensitivity, selectivity and volume to be expected from another R.F. stage; but of those developed for this purpose, few have been found satisfactory. While several manufacturers have produced separate R.F. units to be inserted between the antenna and the first tuned circuit of the receiver, an additional stage of this nature introduces liability to uncontrollable oscillation.

This article is a description of the theory and construction of a unit which will accomplish the long-desired end; it may be connected, by the simple insertion of a plug in the detector socket, to almost any radio receiver, and will improve general results in the all-around characteristics above named. The "Booster Unit" is an addition to the receiver (no parts of which does it render inoperative) of one more R.F. stage; it is simple, inexpensive and may be quickly constructed.—EDITOR.





The above diagrams show in schematic form the way in which the R.F. Booster Unit is connected with two standard types of radio receivers. In Fig. 4 the Unit follows a non-regenerative detector in a tuned-R.F. set; and in Fig. 5 it is placed after a regenerative detector.



This drawing shows the exact location of all holes required for mounting apparatus on front of shield-can. Also, complete details of terminal strip are given.

increase the selectivity. By shortening the length of the antenna, to reduce the pick-up of the receiver somewhat, the selectivity can be still further increased.

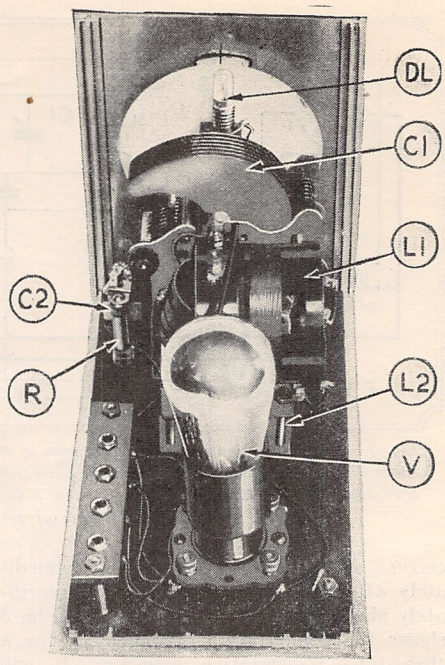
THE POINT OF ATTACHMENT

At least half the novelty of this idea consists in the circuit arrangement, whereby no other connections are made with the exception of the insertion of the plug into the detector socket. This is the only socket into which such a unit could be plugged without disturbing the design of the radio-frequency circuit. Any attempt to connect an additional radio-frequency stage in any of the radio-frequency sockets would result in unbalancing, and cause uncontrollable oscillation. It would completely upset a neutralized or neutrodyne receiver, and would ruin the stabilization of a receiver controlled by the "losser" method.

Furthermore, the choice of the detector socket for this unit was controlled by other considerations as well. It is much easier to locate the detector than any of the radio-frequency sockets. The detector has usually a flexible socket or damping springs. The grid leak is generally mounted near this socket. With the set connected up, ready to operate, the detector tube is "microphonic;" that is, it is easy to identify by gently tapping the tubes with the finger. The tube giving the greatest noise in the loud speaker upon tapping is the tube in the detector socket. The microphonic difficulties in the average receiver were alone sufficient reason for designing this unit for plugging into the detector socket; as changing a standard detector circuit to a radio-frequency stage greatly reduces the microphonic hum, so troublesome when the loud speaker is placed near the receiving set.

The Booster Unit, of course, adds to the receiver one more tube. The additional tube is inserted in a flexible socket at the rear of the tuning unit. The tube which was removed from the detector socket is reinserted in a socket mounted in the top of the plug. (This rule applies only when a standard amplifying tube has been used as a detector; if a special detector of the 200A-type was originally used in the receiver, this tube is inserted in the socket in the Booster Unit and a standard amplifying tube of the 201A-type is placed in the socket mounted in the top of the plug.) It must be noted that the true detector circuit is now contained in the Booster Unit and a special (200A-type) tube is recommended for this circuit.

MR. DAVID GRIMES, whose name is well known to all radio students and constructors, as a radio research engineer and inventor, will be associated with RADIO NEWS *during the coming twelve months as a contributing editor. Mr. Grimes' invention of the inverse duplex system of amplification is his most familiar achievement; but equal originality is shown in the interesting, as well as practically valuable, "Booster Unit" described in this article. He has been doing of late a considerable amount of research experiment, the results of which will be told in the series of monthly articles which begin in this issue and will continue for a year. Readers of* RADIO NEWS, *as well as its editorial staff, will welcome the addition of this distinguished radio authority to the long list of eminent writers who have made its pages the most popular radio literature in the world.*—EDITOR.

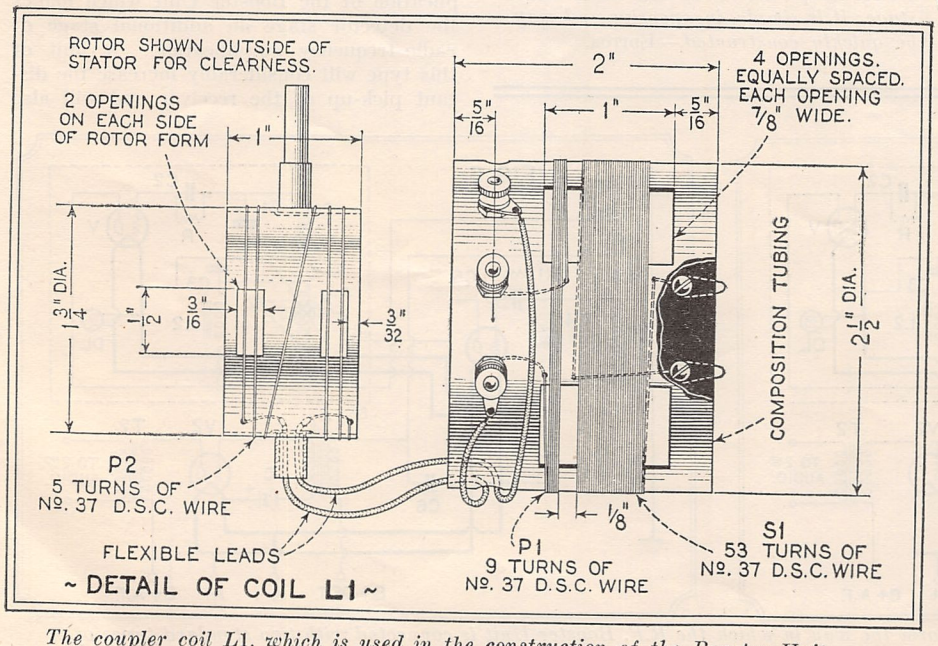


Rear view of R.F. Booster Unit, with sides of shield-can removed. Symbols correspond with those used in text and wiring diagrams.

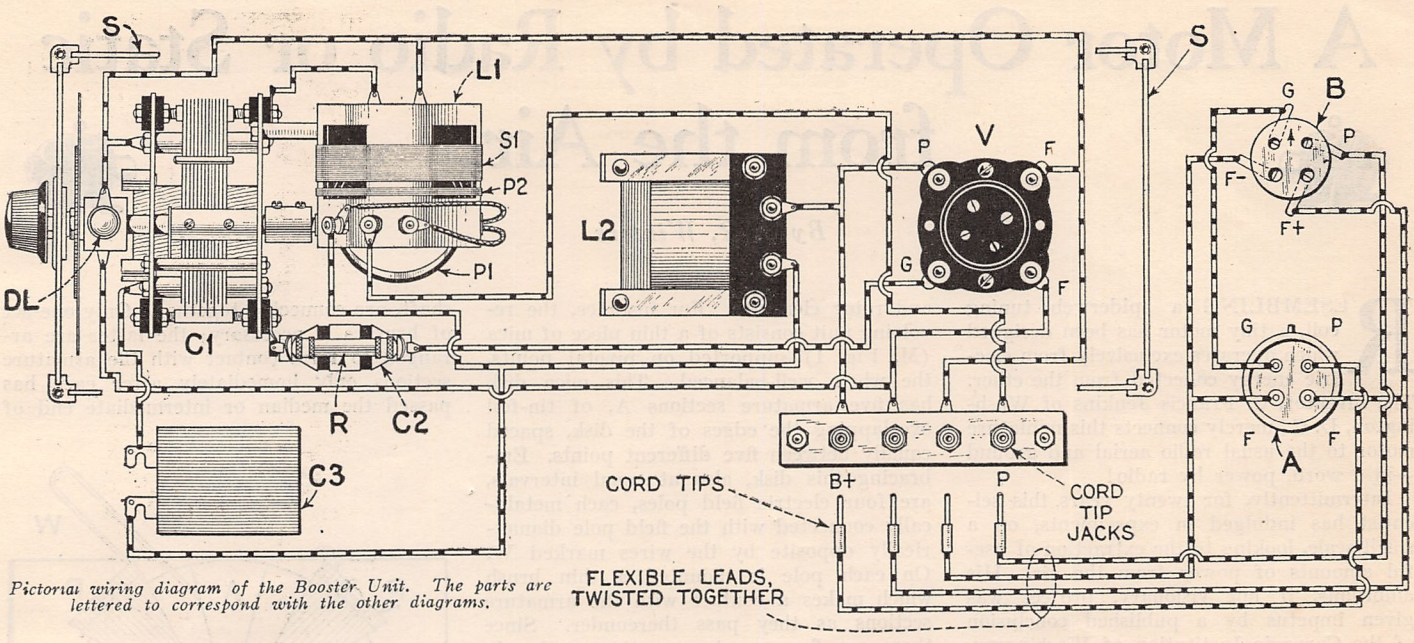
CONSTRUCTION OF THE PLUG

In Fig. 1 the method of connecting the combined plug and socket is shown. This piece of apparatus is easily constructed from an empty tube-base and the top of a flexible UX-type tube socket of the dimensions given on the next page. The cable leads consist of flexible silk-covered wire, such as that used for winding loop aerials; this has been found to be most suitable because of its small size, mechanical flexibility and neat appearance. The free ends of this cord are soldered to cord tips to permit their easy insertion into tip jacks in the unit. This method of connection has been adopted to permit the running of the cord through a small hole in the cabinet; any permanent connection between the unit and the plug would prohibit this convenience. It would be necessary to drape the cord over the top of the set, or a hole sufficiently large to permit the passing of the entire plug would have to be drilled in the cabinet of the radio set.

There are a few minor points, about making the combined socket and plug, that should be here noted. If a new tube-base is utilized, the four brass prongs will be hollow; so that the connection wires may be brought down through and soldered at the bottom. In case an old tube-base is employed, it will be necessary to heat the brass prongs with a soldering iron to melt the solder at the end of the hollow tubes.



The coupler coil L1, which is used in the construction of the Booster Unit, may easily be made at home. Complete details are given in the above drawings.

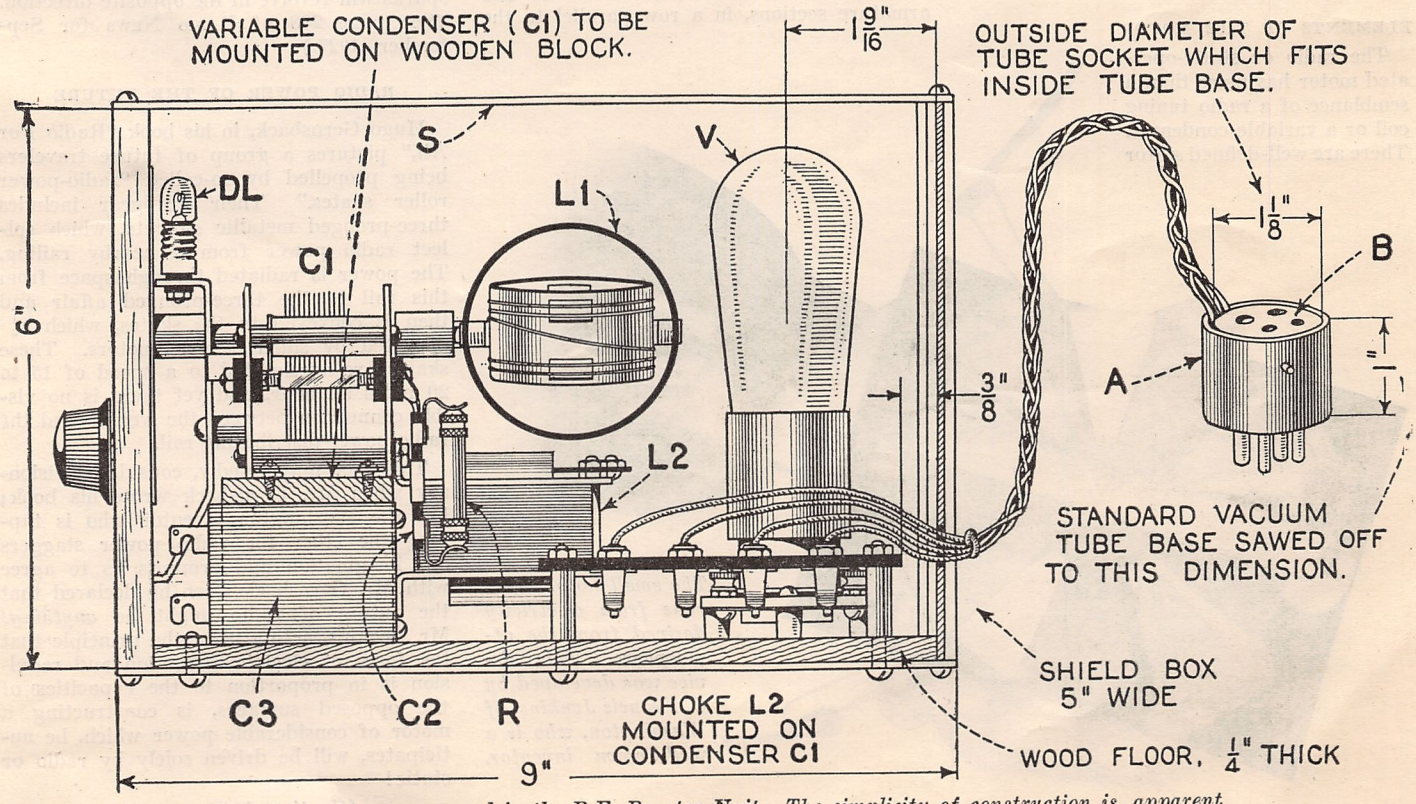


Pictorial wiring diagram of the Booster Unit. The parts are lettered to correspond with the other diagrams.

Then, the connections may be brought down through the prongs and soldered, as in the case of a new tube-base. Some care must be exercised in making the connections between the prongs on the tube-base, the terminals on the inserted tube socket, and the cable leads running out to the unit. Careful attention should be paid to Fig. 1 and the pictorial wiring diagram. The two large prongs in the tube-base constitute the two filament leads which, ordinarily, are connected to the filament of the vacuum tube cemented in the base. The two filament terminals of the socket marked "+" and "—" are connected by leads soldered into the two large prongs above mentioned. No particular care need be taken as to which prong is connected with which filament terminal, for polarity does not matter.

Hold the tube-base with the prongs down and in such a position that the small socket-pin is pointing away from you. It will then be noted that the two large brass (filament) prongs are nearest you. The small upper left prong is the grid connection; the small right prong is the plate connection. The grid spring of the socket is connected directly to the grid prong of the tube base. The plate prong is connected to one of the flexible cable wires and should be marked "B+". The plate terminal of the inserted socket is connected directly to another flexible cable lead to be marked "P." Two additional cable leads are connected to the two filament terminals of the inserted socket, but these are not labeled. The socket is then pushed down into the tube base, with the four cable wires extending up on one side. A small hole is then drilled in the base of the plug and melted paraffine is poured in in order to hold the mechanism intact. Only a little will suffice; as too much will plug the entire inside, preventing the insertion of the tube in the socket. The four wires of the cable may then be braided together, forming a compact strand. This in no way impairs their operation; as the cable does not contain any grid wires, but merely one plate wire, one "B" battery wire and two filament wires. This cable should have a length of about two feet, although this is not at all critical. The extension springs on the socket must be sheared off to a length that will permit the socket to be inserted in the tube base, as indicated in the illustration below.

(*Continued on page* 1268)



How the parts are arranged in the R.F. Booster Unit. The simplicity of construction is apparent.

A Motor Operated by Radio or Static from the Air

By S. R. Winters

RESEMBLING a spiderweb tuning coil, a tiny motor has been designed which operates exclusively from electric energy collected from the ether. The inventor, C. Francis Jenkins of Washington, D. C., merely connects this miniature motor to the usual radio aerial and ground —in a word, power by radio!

Intermittently, for twenty years this scientist has indulged in experiments, on a small scale, looking to the extraction of useful amounts of power from the air. His ambitious, if not visionary, project was given impetus by a published conclusion of the Carnegie Institution of Washington, to the effect that at any specified elevation above the earth there exists a definite electrical potential between that level and the surface of the earth. A three-year survey cruise around the world on the non-magnetic ship *Carnegie* gave conclusive proof in substantiation of this theory.

Tiring of music and speech from a broadcast station, Mr. Jenkins can simply disconnect his radio receiving set from the aerial and ground and attach the wires leading to these to the two terminals on the tiny motor. The latter whirls around as if propelled by a real dynamic force, other than the mere nothingness of the ether! Air charged with electrical disturbances tends to speed up the tiny mechanism, thus giving credence to the theory that static, harnessed in this manner, may become a benediction instead of a malediction. Storms, less electrically disposed, may have the tendency to slow down the small revolving disk.

ELEMENTS OF THE MOTOR

The radio or static-operated motor has more than a semblance of a radio tuning coil or a variable condenser. There are well-defined stator and rotor elements. For instance, the revolving unit consists of a thin piece of mica (M, Fig. 1) supported on pivotal points, the whole well-balanced. This mica disk has five armature sections A, of tin-foil overlapping the edges of the disk, spaced equally between five different points. Embracing this disk, also at equal intervals, are four electric field poles, each metallically connected with the field pole diametrically opposite by the wires marked W. On each pole is mounted a thin brush which makes a contact with the armature sections as they pass thereunder. Since there are five armature sections and only four field poles, at least one of these brushes is always in contact with an armature section.

If one pair of opposite field poles is positively charged with electricity and the other pair is negatively charged, one of the armature sections receives a charge of like sign with the field pole enveloping it. This armature section, consequently, is immediately repelled; moving away from this field pole and toward the next field pole, to which it is attracted for a similar reason. As it passes under the brush of this field pole, its charge of electricity is surrendered for one of unlike sign and is, in turn, repelled by the pole. A similar phenomenon exists at each of the other field poles and, as a result, a continuous rotation of the movable element of this radio motor is maintained, at a relatively high velocity, too.

To increase the torque, or force of rotation, a battery of armature plates is mounted on a single shaft, and all the like armature sections, in a row parallel to the shaft, are connected together. Only one set of brushes is necessary; the latter are arranged to form contact with the armature sections only immediately after each has passed the median or intermediate end of each field pole. The tiny motor, therefore, always turns in the same direction. The behavior of this motor is analogous to a simple example in the early study of electricity; a balanced wire emitting electric sparks will revolve in the opposite direction. (See page 238 of RADIO NEWS for September, 1927.)

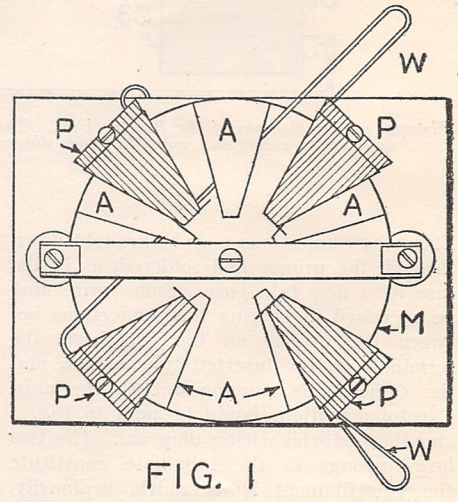
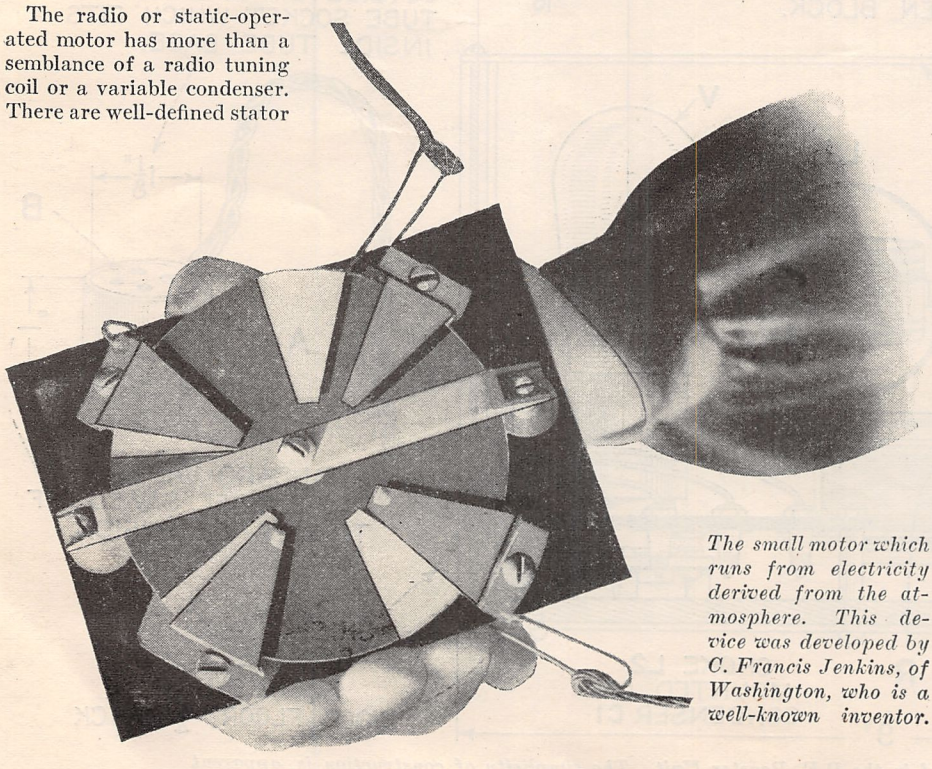


FIG. 1

M is a mica disc on which tin-foil segments, A, are fastened. The poles, P, are connected by the wires, W.



The small motor which runs from electricity derived from the atmosphere. This device was developed by C. Francis Jenkins, of Washington, who is a well-known inventor.

RADIO POWER OF THE FUTURE

Hugo Gernsback, in his book "Radio For All," pictures a group of future travelers being propelled by so-called "radio-power roller skates." Their headgear includes three-pronged metallic gadgets, which collect radio power from a nearby railing. The power is radiated through space from this rail to the three-pronged affair and then is conveyed to the skates, which are operated by small electric motors. These skates are accelerated to a speed of 15 to 20 miles an hour, and yet there is no visible connection between the wearer and the radio-power-distributing rail.

This was, undoubtedly, considered visionary when Mr. Gernsback wrote his book; but the Washington inventor who is tapping the ether for radio power staggers our imagination and prompts us to agree with Mr. Gernsback when he declared that the future of radio might be *anything!* Mr. Jenkins, acting upon the principle that the force of electric attraction and repulsion is in proportion to the capacities of the opposed surfaces, is constructing a motor of considerable power which, he anticipates, will be driven solely by radio or static!

(*Continued on page* 1293)

From Paul Revere to Paul Whiteman

A Lover of Antiques Converts a Colonial Heirloom into a Modern Radio Receiver, and Makes Strange Discoveries

By Charles Strayer

SEVERAL years ago the writer, a radio enthusiast—and nut—as well as a lover of the beautiful, conceived the idea of building radio receivers into suitable pieces of furniture, such as old consoles, cabinets, chests and other odds and ends of household sentiment or antiquity.

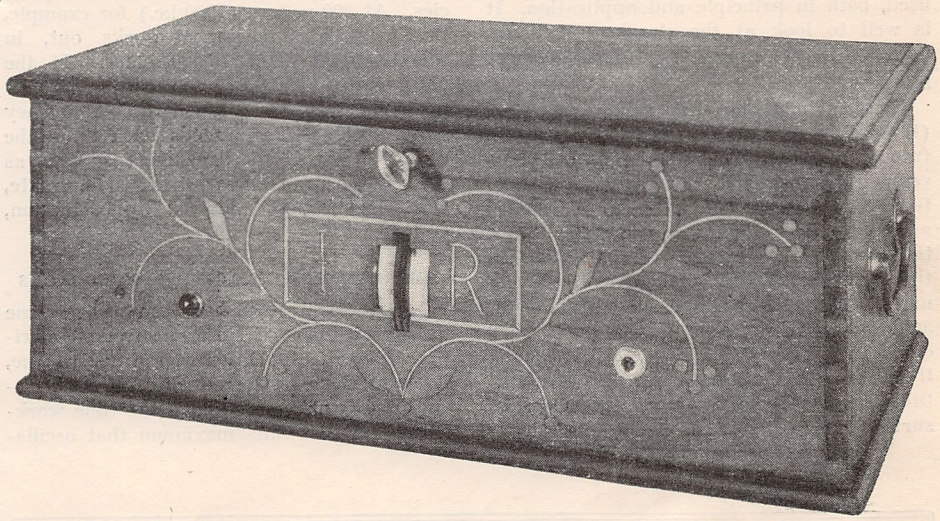
In the pursuit of this plan, an old chest came into his possession through a local dealer in antiques, in the Virginias. It is made of solid golden-brown walnut, with an inlaid scroll design of satin and boxwood on the front wall, as shown in the accompanying illustration. Aside from the simple beauty of line and proportion and the rich, time-mellowed grain, there was apparently nothing unusual about this particular chest, other than attaches to many old pieces of earlier days.

The cabinet was known as a Treasure Chest in former times. In fact, it has been traced back three generations, and is well remembered by a gentleman, now living, as having been used by his grandmother for a jewel case. On the bottom, which is well worn and securely fastened with hand-forged nails, is deeply carved the date "1771".

In the writer's desire to get off the beaten path in building radio sets and in his reluctance to cover up the design on the front panel with sundry mechanical and scientific-looking discs, knobs and dials, he turned to the modern and efficient drum-control method of tuning.

A STARTLING DISCOVERY

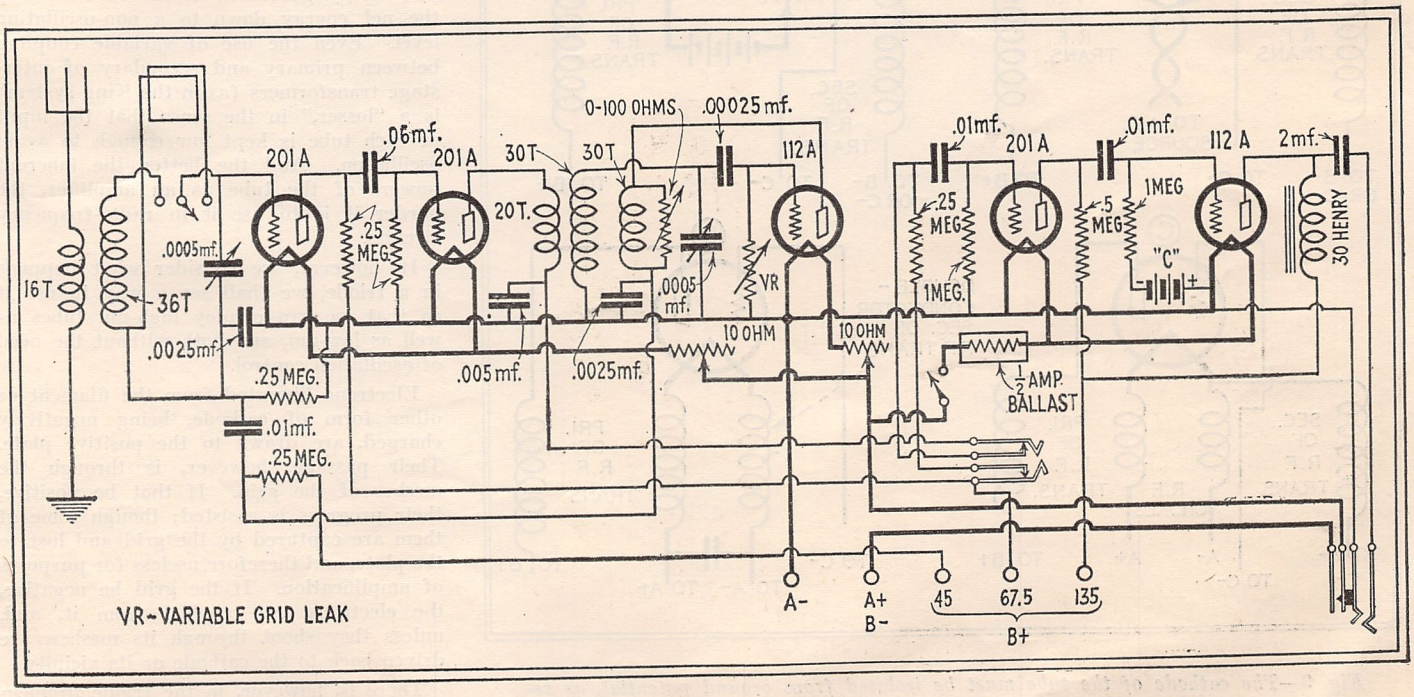
In the use of this method it became necessary to cut a small, rather irregular, "port-hole" in the front wall between the inlaid initials "I. R." However, no great endeavor was exercised when cutting this opening, to preserve intact the pieces of wood which came out. So, the panel was drilled in several places, "jigged" out with a coping saw and the pieces allowed to drop rather heedlessly, until it was noticed that the little rectangular, panel-like design, which held the large initials "I R", was, in fact, a very real and secret panel; between which and the cabinet wall, in a pocket about an inch deep, two inches wide, and five inches long, were hidden the "documents" which were subsequently mounted under the lid of the chest.



This 157-year-old chest may have held treasure; it did hold mysterious documents through a century.

Needless to say, upon first making this discovery, stories of Captain Kidd and his

(*Continued on page* 1277)



The schematic circuit of the "Treasure Chest" receiver. The R.F. transformers are spiderweb coils wound with No. 28 D.S.C. wire. When the intermediate jack is used, a bakelite plug is inserted in the output jack, to light the filaments.

A New System of Radio-Frequency Amplification

A Circuit Interesting to Experimenters Who Would Like to Develop Into a Finished Receiver a Set Having Great Possibilities

By Arthur T. Brown

A METHOD of using three-element vacuum tubes for radio-frequency amplification, without the necessity of stabilizing devices, has been invented by the writer. It differs radically from any method that is in use now or, so far as the writer knows, has ever been used, both in principle and application. It is well to look at the standard methods, however, before explaining the method here published.

Present methods of using "triodes" (three-element vacuum tubes) in radio-frequency amplification have all been developed to overcome the tendency of the tube to oscillate with provoking ease—in a circuit of even a moderate efficiency. That tendency is due to the capacity between the elements of the tube. All three elements, plate, grid, and cathode (filament) act as condenser plates in relation to each other, in addition to which the leads through the base and the "mash" of the standard tube must be added as miniature condenser surfaces. (See Fig. 1).

Now, since the reactance of a given capacity varies inversely with the frequency put across it, it is easy to see that even the small capacities in the triode (in the 201A, for example, they are of the order of 5 to 10 mmf.) become a serious factor in one-way amplification of radio frequencies. At 300 meters (1000 kc.) for example, the grid-plate reactance works out, in round numbers, at 16,000 ohms. If the plate load equals this, or is greater, as may easily be the case in tuned radio-frequency amplification, energy feeds back from the plate to the grid directly (as well as through the load) thence back to the plate, and regeneration, followed by oscillation, occurs.

OVERCOMING CAPACITIVE FEEDBACKS

The problem, then, has been to overcome the effects of these inter-electrode capacities. Prior to invention of the neutrodyne, this was done by introducing into the circuit losses sufficient to keep the tube working so far below its maximum that oscillation did not occur; *e.g.*, by a positive grid bias through a potentiometer. The neutrodyne method consists of feeding back, from the output tube to the grid, energy in opposite phase to that on the grid. The Hazeltine, Roberts, Rice, and superdyne methods are all ways of accomplishing this end. They, too, are "losser" methods; since they use energy generated in the tube to keep the net energy down to a non-oscillating level. Even the use of variable coupling between primary and secondary of interstage transformers (as in the King system) is a "losser," in the sense that the input of each tube is kept low enough to avoid oscillation. And the better the inherent powers of the tube as an amplifier, the harder it is to use it in radio-frequency circuits.

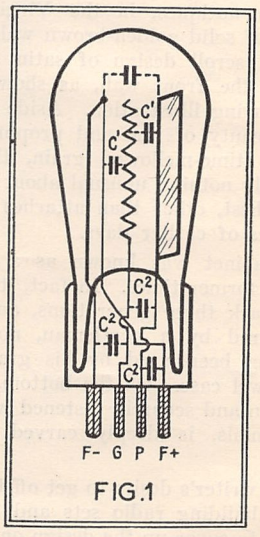


FIG.1

The condensers indicated in the sketch above illustrate the capacity effects between the three elements of a vacuum tube and their leads.

If, however, we consider what happens in a triode, we shall see a way to use it so that we can employ high-mu tubes as well as low-mu, and both without the need of oscillation control.

Electrons liberated from the filament or other form of cathode, being negatively charged, are drawn to the positive plate. Their passage, however, is through the meshes of the grid. If that be positive, their progress is assisted; though some of them are captured by the grid and lost to the plate, and therefore useless for purposes of amplification. If the grid be negative, the electrons are repelled from it, and, unless they shoot through its meshes, are driven back to the cathode or its vicinity.

There is, however, in the triode problem another important consideration: the space charge between cathode and grid. This consists of countless liberated electrons

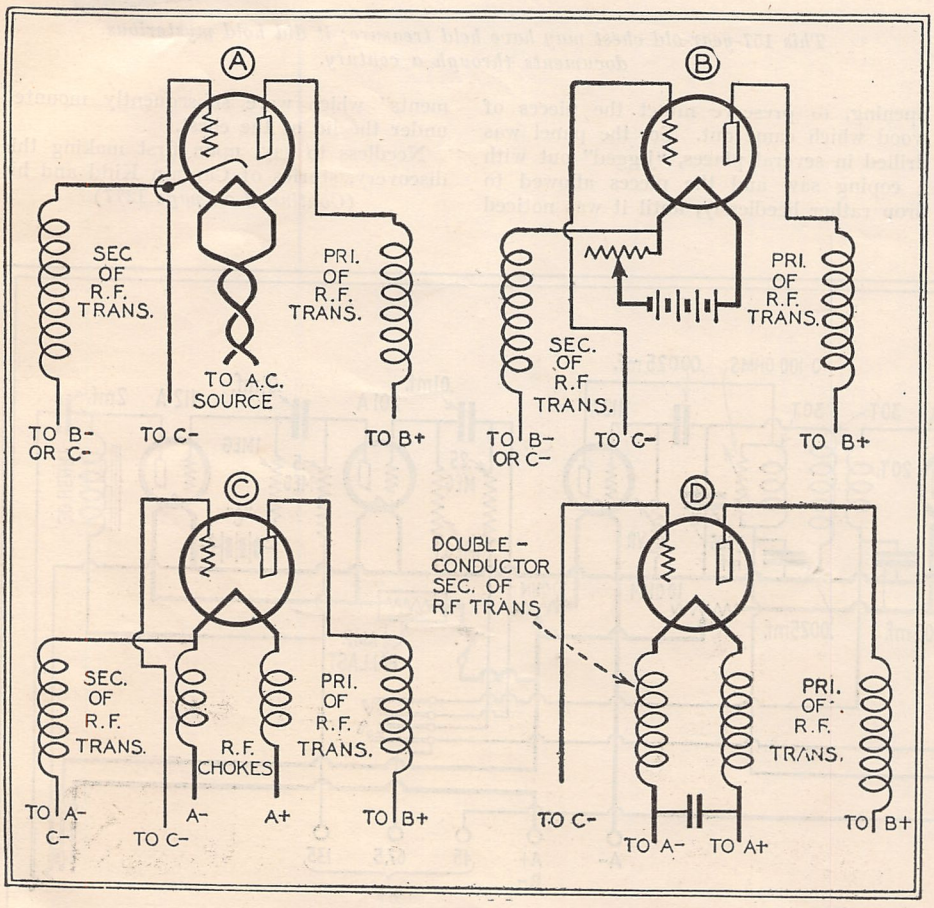


Fig. 3—The cathode of the tube must be isolated from ground potential, as regards radio frequencies. This is easily done in the heater-cathode tube shown at 3A; but in 3B a separate "A" battery must be used for each tube. In 3C, R.F. chokes are used; while the best device, a dual tuned choke, is shown in 3D.

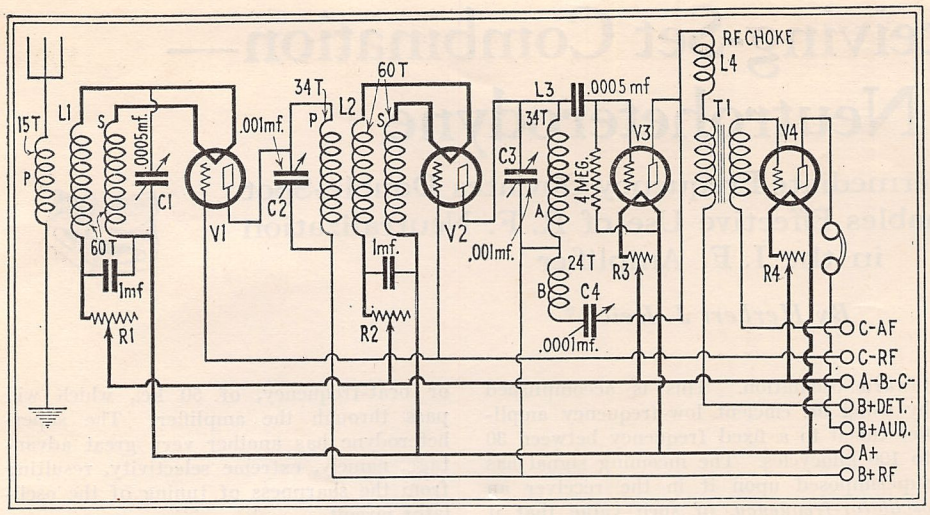


Fig. 4—Schematic diagram of receiver. No. 20 D.C.C. wire is used in secondaries of L1 and L2 and also A and B of L3. No. 18 D.S.C. is used on primary of L1, and No. 24 D.S.C. on primary of L2. All coils are wound on 3-inch tubing.

that, with their varying speeds, interfere with each other, and prevent some from getting very far away from the cathode, toward which (particularly its positive end, since they are negative) they are drawn. See page 897, Radio News for February, 1928, for illustration.

Now, when the grid is positive, it tends to reduce the space charge, pulling it away from the cathode, making the crowding less, and reducing the effect of the cathode on the charge. On the other hand, when the grid is negative, it tends to keep the space charge both denser and closer to the cathode, making, therefore, the flow to the plate less, and raising the impedance of the tube.

THEORY OF A NEW METHOD

If, now, we make the cathode the *input* to the tube, connect the plate in the usual way, and use the grid as a means of keeping the space charge close to the cathode, several important differences in performance will result.

Consider the action of the cathode first: As the radio-frequency alternations of potential appear on the cathode, they change, at the rate of their own frequency or frequencies, its average potential, making it slightly more positive or more negative. When the cathode is more positive, *its rate of electronic liberation is decreased* (thereby decreasing the plate current) while, at the same time, the space charge is drawn closer to it. When the cathode is more negative, the electronic emission is increased and the space charge driven further away. In short, the rate of the emission of electrons is conditioned by the voltages impressed on the cathode, the changes in rate being at the frequency impressed. There is thus a control, within certain limits, of the electronic stream at its source. This control in the liberation of electrons is further augmented by a control, *in like phase,* of the space charge. Thus a considerable portion of the total emission is controlled by impressing the radio-frequency potentials on the cathode. It is evident that the control so imposed by the cathode on the space charge is effective substantially *in inverse ratio to the cube of the distance of each electron in the charge from the cathode.* Hence it is important to keep the space charge close to the cathode.

USE OF GRID

This effect can be gained by keeping the grid of the tube at all times negative in

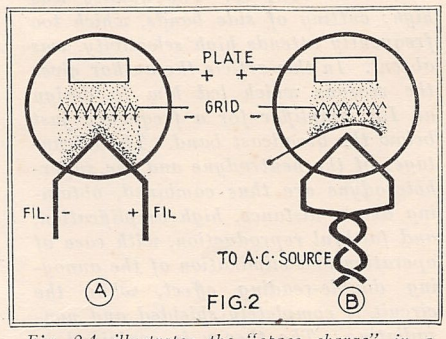


Fig. 2A illustrates the "space charge" in a D.C.-operated tube; and at B is shown the same effect when operating on A.C. The grids in each case require a negative charge to keep the space charge close to the cathode.

respect to the cathode, or any part of it. If we put a negative potential on the grid, it keeps the space charge closer to the cathode than it would be otherwise; and so aids the cathode in controlling the electronic stream. This is the only function of control which the grid has in the system here described.

The grid performs, nevertheless, another very important function when thus, in effect, grounded. Its position between cathode and plate, its construction (a mesh with relatively wide interstices), and its connection to the point of lowest potential in the circuit of the tube, result, substantially, in *grounding the inter-electrode capacities* of the tube. Thus the cause of the oscillation of the triode, when ordinarily connected in circuit, is removed and, in fact, the tube used as here outlined will not oscillate easily even at high frequencies.

The basic action of the tube in this system is shown diagrammatically in Fig. 2. A shows the ordinary battery-operated tube in which the cathode consists of an electron emitting filament. B shows the heated-cathode (Y-227) type in which the filament has the sole function of heating the cathode, which thereby becomes a source of electrons. In both the electronic stream is indicated between cathode, grid, and plate. The cloud of them next to the cathode creates the space charge, kept close to the cathode by the repelling effect (shown by arrows) of the negatively-charged grid. The radio-frequency potentials induced in the cathode decrease or increase, alternately, the liberation of electrons and the closeness of the space charge to the cathode. When the charge on the cathode is more positive than its average value, the electrons are held by it, fewer fly off, and the space charge is drawn to the cathode. When it is more negative, the opposite is true—more electrons are driven off, and the space charge is pushed further away, so that more of its contents fly through the grid to the plate.

FILAMENT-BIASING VOLTAGE

Now, in ordinary practice, the cathode of the tube is at or near ground potential. The problem here is to keep it *isolated from ground potential,* so that the radio-frequency input will be effective. With the heater type of tube (Fig. 3A) the problem is a simple one. With the filament type (ordinary cathode) the problem is not so simple. Several methods are possible (Fig.

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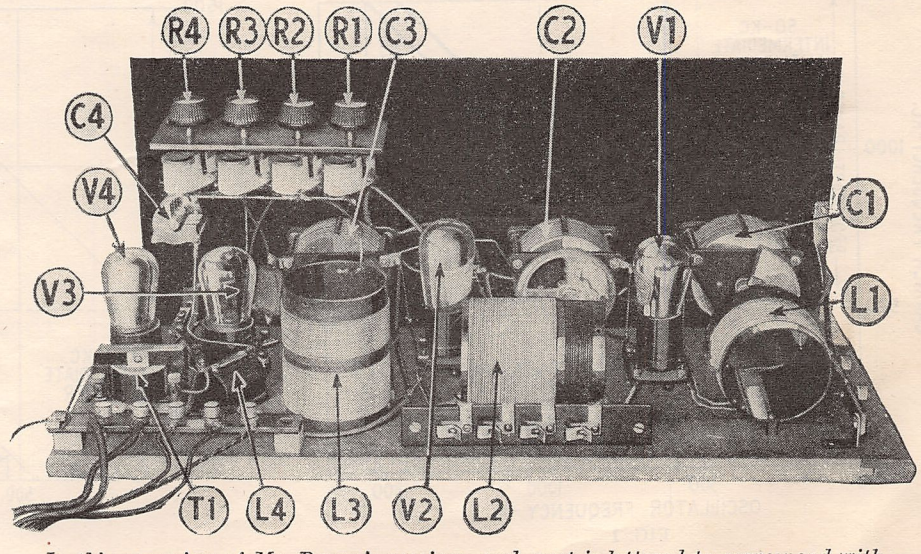
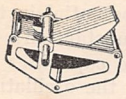
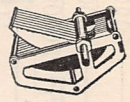


In this rear view of Mr. Brown's receiver, each part is lettered to correspond with the schematic diagram above. The capacity of C1 is .0005-mf.; of C2 and C3, each .001-mf.; and of C4, .0001-mf. L4 is an 85-millihenry R.F. choke.

A New Receiving-Set Combination—the Neutroheterodyne



Use of High Intermediate Frequency Obviates Double-Spot Tuning and Enables Effective Use of R. F. Neutralization in the I. F. Amplifier



*By Herbert J. Reich**

THE last few years have seen a marked improvement in all types of receiving sets, but practically all present-day sets make use of one of three fundamental circuits, the regenerative, the tuned radio-frequency, or the superheterodyne. Several other circuits, such as the untuned radio-frequency, reflex, and super-regenerative, have proved less satisfactory for most constructors, and hence are little used.

The regenerative circuit was for a long time the most popular because of its simplicity, cheapness, and efficiency. Its main disadvantage lies in the fact that it is usually the cause of serious annoyance to the users of other receivers for miles around. Moreover, it is unable to give sufficient amplification to operate a loud speaker on distant stations without being forced to the point of distortion.

The use of one or more stages of tuned-radio-frequency amplification, ahead of either a regenerative or non-regenerative detector, results in a fairly sensitive receiver. The main difficulty that must be overcome in such a receiver is the tendency toward oscillation as the result of interstage coupling. This may be partially overcome by neutralization and by careful arrangement of apparatus. The recent development of the shielded neutrodyne has completely overcome this defect, and resulted in a set which offers exceedingly high efficiency, good selectivity, and wonderful tone quality.

The superheterodyne circuit was developed in order to take advantage, in the reception of broadcast frequencies, of the high amplification which may be obtained at much lower frequencies without tendency toward oscillation. This is accomplished by using an efficient low-frequency amplifier tuned to a fixed frequency between 30 to 100 kilocycles. The incoming signal has superimposed upon it in the receiver an *oscillator-frequency,* of such value that it produces a *beat-frequency,* which corresponds to the tuned frequency of the amplifier. Thus we may have an intermediate-frequency amplifier tuned to, say, 50 kilocycles. To receive a 1000-kc. carrier we tune our oscillator to a frequency of either 1050 kc. or 950 kc.; giving us a difference, or beat-frequency, of 50 kc., which will pass through the amplifier. The superheterodyne has another very great advantage, namely, extreme selectivity, resulting from the sharpness of tuning of the oscillator circuit.

THE receiver described in this article, when demonstrated in RADIO NEWS *Laboratories, proved remarkable in both its sensitivity and its quality; it went down to the "noise level," demonstrating that it gives all the power which can be used. The quality was high; cutting of side bands, which too frequently attends high selectivity, was absent. In this article the author gives the reasons which led him to design an I.F. amplifier for a frequency just below the broadcast band. The advantages of the neutrodyne and the superheterodyne are thus combined, obtaining ample distance, high amplification, and faithful reproduction, with ease of operation and elimination of the annoying double-reading effect, while the circuit is completely shielded and non-radiating. The theory is explained in this article, while complete constructional information and plans will appear in a forthcoming issue.*—EDITOR.

SUPERHETERODYNE PROBLEMS

It has, however, one very great disadvantage. It will be noted that, in order to receive a 1000-kc. station, it is possible to tune the oscillator to either of two settings; except at the ends of the tuning range of the oscillator, there are two settings of the oscillator for every station. It is evident that the upper setting for one station will correspond to the lower setting for some other station. Thus, the 1150-kc. setting for the 1000-kc. station will also give a 50-kc. beat frequency with a station operating on 1100 kc.; and the 950-kc. setting with a third station operating on 900 kc. (See Fig. 1). The detector does not tune sufficiently sharp to eliminate the undesired station, which differs in frequency from the desired station by only 100 kc.; and hence the modulation of the undesired station produces interference. If either the intermediate amplifier, one of the stations, or the oscillator is slightly off its proper frequency the two beat-frequencies will not be exactly alike and there will result, in addition to the interference of the modulated frequencies, an audible heterodyne whistle.

If the intermediate frequency were not an exact multiple of 10-kc., but were, for example, 52-kc., then to receive the 1000-kc. station we would set the oscillator-frequency at 1052-kc. or 948-kc. It would then give a 48-kc. beat-frequency with the

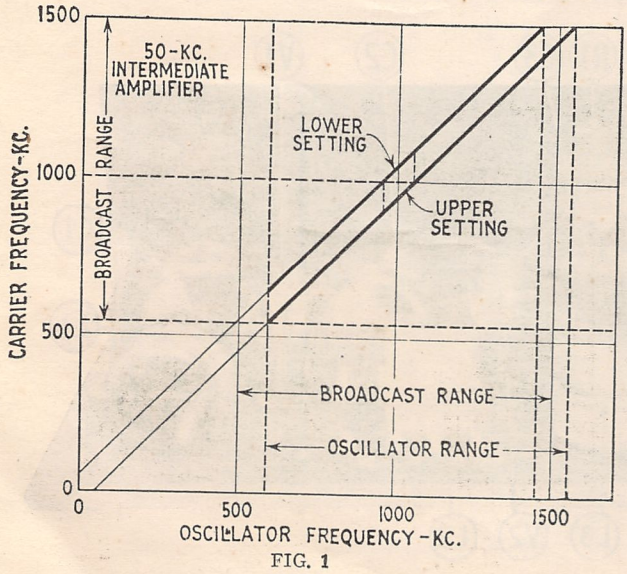


FIG. 1

In the ordinary superheterodyne, operating at say 50 kilocycles, practically every station in the broadcast band tunes in at two settings of the oscillator dial; as may be seen from Fig. 1 (left).

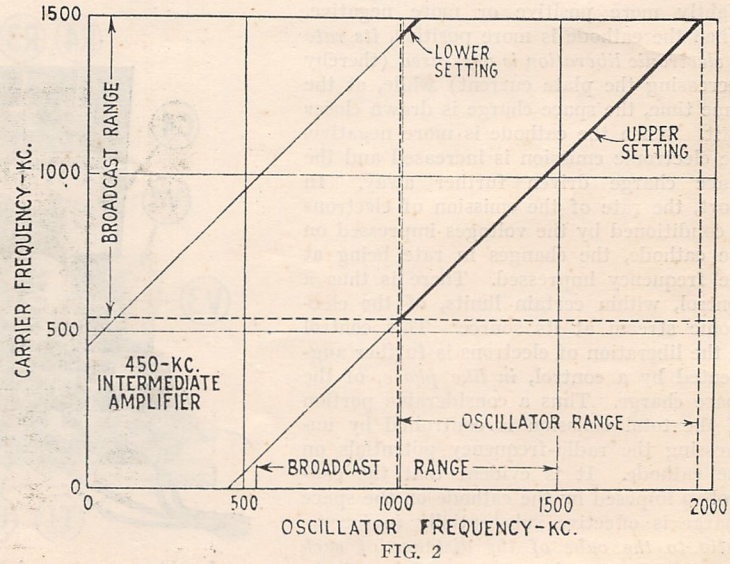


FIG. 2

If we use instead a high frequency like 450 kc., we reduce the effect to its minimum—the last six low-wave channels of the band—as demonstrated in Fig. 2. The first detector easily tunes these out.

* *Physics Department, Cornell University*

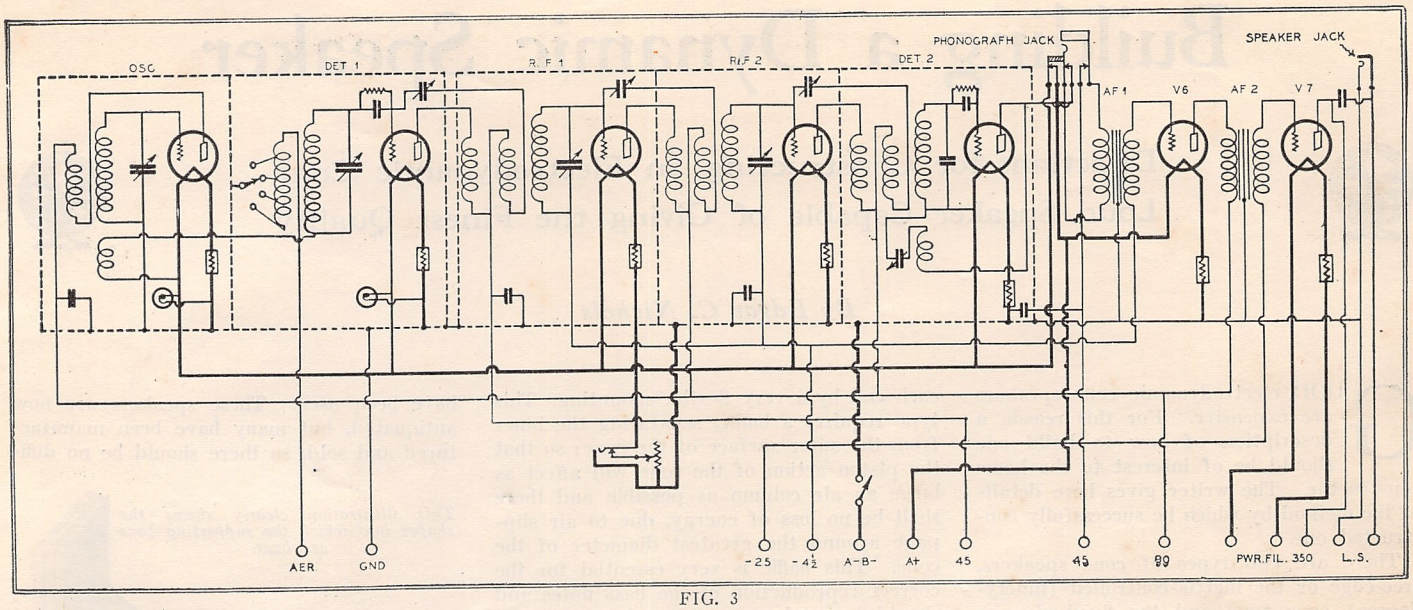


FIG. 3

In this schematic diagram of the 461-kc. superheterodyne here described, the separate shielding of the oscillator, first-detector, first and second intermediate (R.F.), and second-detector stages is indicated. The values of parts, layout, etc., will be given with working drawings in the June issue.

1100-kc. or 900-kc. station, which would heterodyne the desired 52-kc. beat-frequency and produce a 4-kc. audible whistle. A similar effect may be caused by another station of 1150-kc. or 950-kc. acting as the oscillator for the 1000-kc. station.

In any such case, variation of the oscillator setting will change the value of both the desired and the interfering beat-frequencies, raising one and lowering the other; and so the pitch of the audible whistle will change as the set is tuned. The addition of a stage of tuned radio-frequency amplification ahead of the first detector helps somewhat in tuning out the interfering stations, but does not completely solve the difficulty; particularly in a metropolitan district where there are many powerful stations, and it adds complications.

CHOICE OF BEAT-FREQUENCIES

How, then, can we remedy this trouble? The obvious answer is by using such an intermediate frequency that there will be only one oscillator setting for each station, which is in itself an advantage in operation. This may be done by using an intermediate frequency of about 450-kc., as is evident from a study of Fig. 2. Only at the extreme high-frequency end of the broadcast band is it possible to find a second oscillator setting, for either the oscillator *fundamental or the first harmonic.* In the very short interval at the low-frequency end of the broadcast band, in which the oscillator can heterodyne two stations simultaneously, the undesired station is separated from the desired station by 900-kc., practically the entire width of the broadcast band. The detector's tuning is sharp enough to cut out completely the undesired station, and hence no interference of the type just described can take place. The same holds true for the nearest station which might act as an oscillator.

In the superheterodyne circuit just described we have gained several advantages over the tuned-radio-frequency circuit. We have retained the extreme selectivity and simplicity of control of the superheterodyne and even, though we amplify at a relatively high frequency, we amplify at just one frequency, instead of over the whole broadcast band, and therefore obtain uniform and stable amplification. It is not difficult to build a stable amplifier tuned to 450-kc.; since the greatest difficulty in stabilizing is encountered at frequencies corresponding to the high-frequency end of the broadcast band, or higher.

There still remains possible one important improvement; substitution, for the ordinary unshielded intermediate-frequency amplifier, of the newly-developed neutralized and shielded radio-frequency amplifier, which, because of its proper design, gives as much amplification as the low-frequency amplifier ordinarily used in the superheterodyne, and is nevertheless perfectly stable.

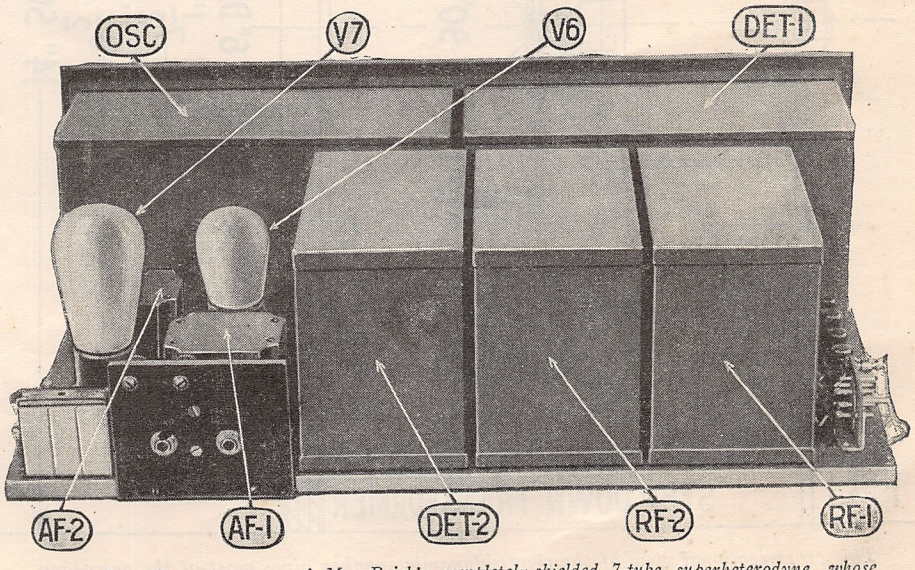
PREVENTION OF RADIATION

The use of this high-intermediate-frequency amplifier makes it possible also to reduce to a negligible amount the radiation of oscillator energy. Since, in the ordinary superheterodyne, the oscillator is tuned to almost the same frequency as the first detector (see Fig. 1), a large amount of oscillator energy is radiated by the antenna. With the 450-kc. intermediate amplifier, however, the antenna circuit is tuned to an entirely different frequency from that of the oscillator, and therefore such radiation may be almost completely prevented; providing the capacity between the primary and secondary windings of the antenna coupler is kept to a very low value.

Now let us examine for a moment the shielded neutrodyne; two important difficulties must be overcome in the design of this receiver. The first of these is the simplification of its operation; the use of two or more stages of tuned-radio-frequency amplification results in at least three tuning condensers. Unless tuning is to be broadened to an undesirable degree, this necessitates the use of either vernier condensers or some complicated system of cams, cut for the individual set after completion. None of these methods is entirely satisfactory, for obvious reasons.

The second problem is that of obtaining uniform amplification over the whole broadcast band. It is a well-known fact that radio-frequency amplifiers are much more efficient at low than at high wavelengths. To remedy this, various schemes have been adopted, such as varying the primary-to-

(*Continued on page* 1279)



The workmanlike appearance of Mr. Reich's completely-shielded 7-tube superheterodyne, whose schematic diagram is shown above, can be seen at a glance from this picture. Complete constructional details will be given in the continuation of this article next month.

Building a Dynamic Speaker

Directions for Constructing an Electrodynamic Cone Loud Speaker Capable of Giving the Finest Quality

By Edgar C. Nichols

GOOD electrodynamic cone speakers are expensive. For this reason a description of how to build one should be of interest to the home constructor. The writer gives here details of the method by which he successfully constructed one.

There are two types of cone speakers, free-edge or the inertia-controlled (ninety-degree) cone type and the fixed-edge or wave or flat-cone type. The former has been chosen as the one which will give the best results for the home speaker, inasmuch as this type reproduces all sound frequencies at any volume. In the flat-wave cone type there is a tendency to cut off the bass notes when operating at lesser volume. This type of cone vibrates within itself, reproducing the higher notes by the vibration of a small area about the center of the cone and the bass notes by vibration of the entire cone area. Therefore, unless sufficient volume is used the bass notes are lost.

In the inertial type of cone speaker the sound is reproduced by the *piston action* of the rigid cone, which is supported at each end by a very flexible mounting. This type requires a baffle, separating the inner from the outer surface of the cone; so that the piston action of the cone will affect as large an air column as possible and there shall be no loss of energy, due to air slippage around the greatest diameter of the cone. This baffle is very essential for the correct reproduction of the bass notes and should be made as rigid and as large as possible, within reason; that is, from fourteen to eighteen inches square. If the speaker is put in a case, the back should be left open so that volume may not be sacrificed. This case, too, may be considered a part of the baffle.

OBTAINING THE COILS

To simplify as much as possible the construction of the speaker, parts from a Magnavox horn speaker, type R3, model B, have been used. These speakers are now antiquated, but many have been manufactured and sold, so there should be no difficulty in securing one at a low cost. From this speaker we may obtain the electromagnet for the field and the armature coil for actuating the cone. To make coils of so many turns is impracticable for the home constructor. The bridge, which was used in the old Magnavox speaker to mount the diaphragm, may be used in our speaker as an adjustable mounting for the armature coil and the apex of the cone. The input transformer is used "as is" for the new speaker.

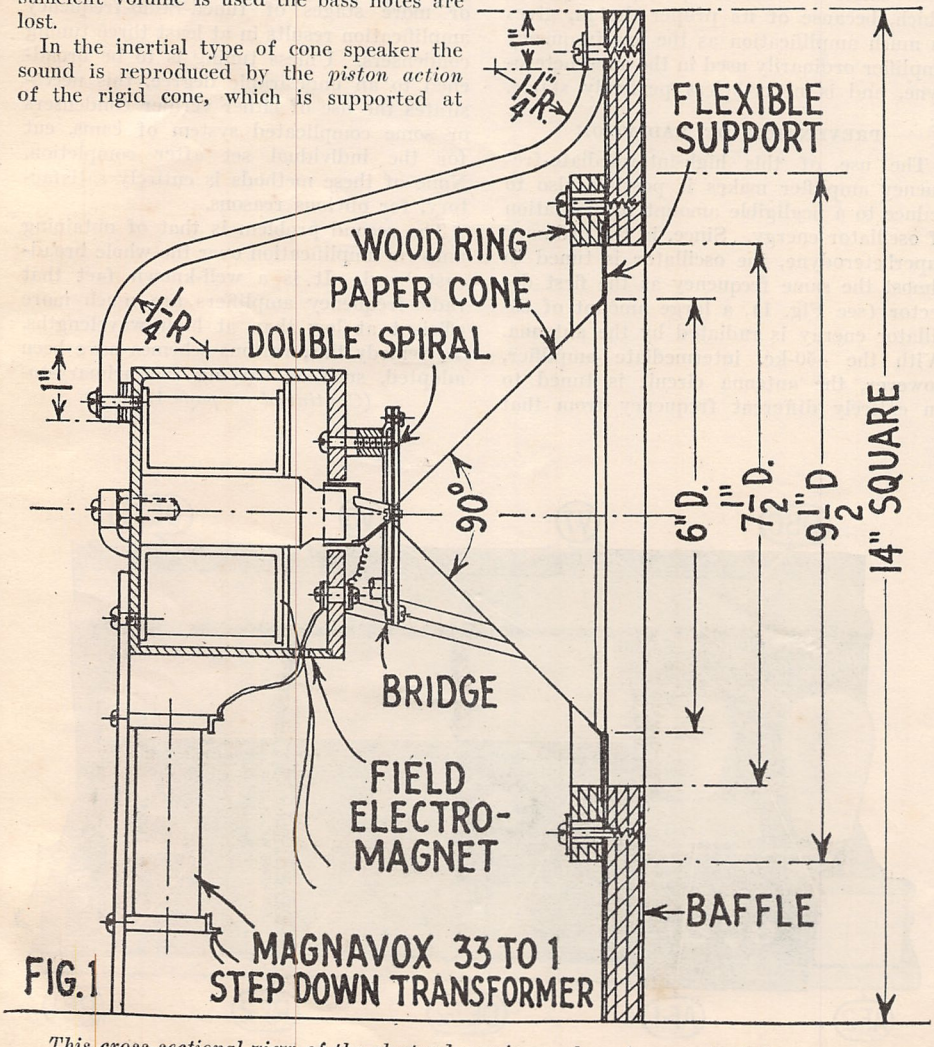
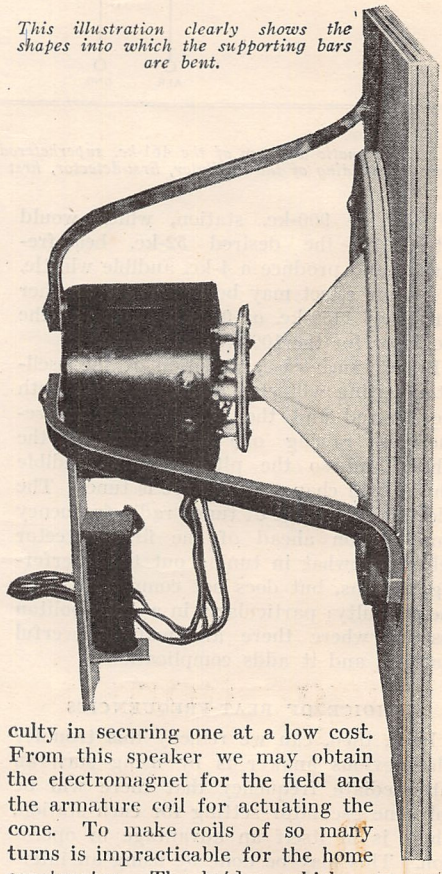


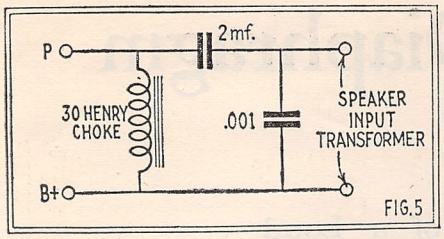
FIG. 1

This cross-sectional view of the electrodynamic speaker gives most of the necessary dimensions; the other details being shown on the next page.

This illustration clearly shows the shapes into which the supporting bars are bent.



The success of the speaker depends upon the rigidity of its construction and, as the field electromagnet is very heavy, it must be well supported. This is accomplished by three ¼ x ½-inch brass rods, which are bent to shape as shown in Fig. 1. The brass is annealed before bending, by heating it to a dull red and then plunging it into cold water. These rods are fastened to the electromagnet by screws at the back of the magnet. The magnet is aligned by using washers as shims under these screws; so that it is actually adjusted to the axis of the cone. There is also required a vertical leg, made of bakelite or hard rubber, for a back support. The input transformer may be mounted on this leg. The electro- or field magnet draws one ampere at six volts, for a "flux density" of approximately sixty thousand lines per square inch. This current may be supplied from the radio



A filter circuit for use before the primary of the speaker input transformer, which is wound with very fine wire.

"A" battery or by the use of a full-wave trickle charger.

When dismounting the old speaker great care must be taken to see that the fine wires of the armature coil, which is mounted on the diaphragm, are not broken. This armature coil must be so arranged in the new speaker that it may be adjusted to the field electromagnet. To accomplish this it is mounted in the center of a double spiral made of very thin sheet formica or celluloid. (See Fig. 2). This is done in the following manner: the coil proper is supported on a tripod, which in turn is bolted and cemented, with household cement, to the center of the double spiral. It is very important that the axis of the armature coil shall be at right angles to the plane of the double spiral. This double spiral, in turn, is clamped by the bridge which, in the old speaker, mounted the diaphragm. The old diaphragm is discarded. The armature coil leads are then connected to their terminals on the electro-magnet, by means of helices made of very fine enameled wire. The coil is adjusted so that it cannot strike the poles of the electromagnet and the double spiral is clamped in place.

CONSTRUCTING THE CONE

The next step will be to manufacture and mount the cone, which is made of a cold-pressed "water-color" paper. By many experiments this paper has proved to be the best for this purpose. The cone is six inches in diameter and the included angle is 90 degrees. (See Fig. 3 for details of this cone.) The two edges for the glued joint are "feathered" with a razor blade in order to make a smooth job. Liquid glue is used here, being put on both edges, which are then placed together with a 1/16-inch lap and protected on each side by a strip of paper. A pencil is then laid lengthwise of the joint and the whole is clamped by means of a wood clamp to a table until the joint is thoroughly set. When the cone is released the paper strips placed to protect the joint are carefully torn away. A narrow strip will remain along the joint, but this is not objectionable.

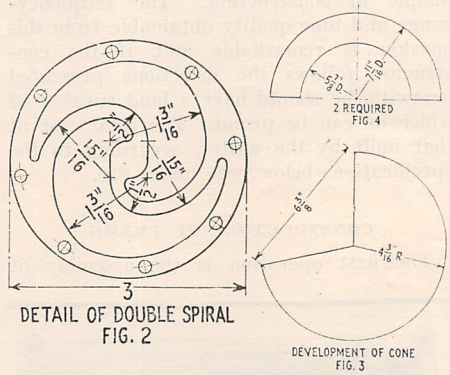
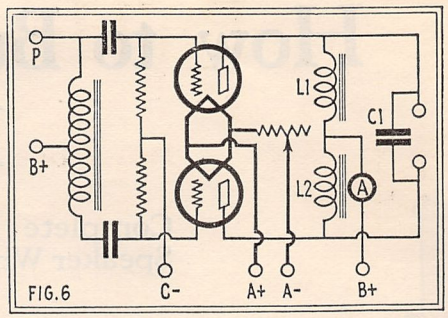


Fig. 2 shows the double spiral on which is mounted the armature coil; Fig. 3, the dimensions of the paper cone; and Fig. 4 the dimensions of cone support.



A push-pull stage of A.F. amplification will supply undistorted power to the dynamic speaker.

The larger end of the cone is supported by a flexible ring made of bookbinders' "skives" of thin leather, or a support made of "gold beaters' skin" may be used. If the latter is used it must be treated with glycerine after it is mounted, to take out the rustle. Liquid glue is about the only cement which will hold gold beaters' skin to the paper cone and it must set thoroughly. The skin must be cleaned with gasoline to remove any grease, before the glue is applied. Care must be taken that the skin is not stretched tight, especially as the glycerine has a shrinking effect. If it is too tight a drumming effect will be produced, which is undesirable. (See Fig. 4 for details of this flexible support.) ("Gold beaters' skin" is a thin membrane, similar to sausage cases; and it is quite possible that a good quality of the latter, or perhaps a bladder, could be used for this purpose. "Skives" are very thin parings of soft leather, which must be made with an extremely sharp blade.—EDITOR.)

(*Continued on page* 1271)

Suggestions for Power-Amplifier Current Supply

How Batteries for a Power Tube Can Be Added to a Receiver, Increasing the Volume and Quality of Reception

IT frequently happens that the owner of a radio receiver thinks he is unable to use a power tube in the last stage of his audio amplifier, for the reason that his "B" socket-power unit is unable to supply the necessary high voltage. This is particularly true in neighborhoods supplied by direct current, and also in the case of some A.C. power units having a total output of 135 volts.

In territories where direct current only is available, operation from a "B" power unit is not entirely satisfactory, for the reason that the 110 volts usually available from the wall socket cannot be stepped up, as in the case of A.C.; and consequently, the output seldom exceeds 100 volts and, generally, is considerably less. Obviously, if the set owner is to depend on his power unit alone, it is impossible to expect satisfactory results from the use of a power tube of the 171A type, since the minimum voltage required for these tubes is 135 volts, and the maximum 180 volts. This is an altogether unsatisfactory condition of affairs; for modern standards of reception demand the use of a power tube in the last stage of the audio amplifier, if the sounds issuing from the loud speaker are to have all the volume and realism expected of present-day radio.

The set owner may, however, enjoy the advantages of power amplification at small cost by the simple expedient of using a 45-volt heavy-duty "B" battery in connection with the power unit. In the case of D.C. "B" power units, one battery should be used for a total of 135 volts, and two batteries where 180 volts is desired, in order to secure the maximum output of which the UX-171A tube is capable.

In some cases where the original output of the power unit is around 100 volts, it is obvious that the addition of "B" batteries would make the total output voltage slightly in excess of that specified by the manufacturer of the power tubes. This should not, however, occasion concern, for the reason that the resistance of the audio transformers, impedance units or other coupling devices causes a voltage drop and, consequently, the voltage at the tube socket will not be greater than specified.

The batteries should be connected in series with the power unit in the following manner: the positive, or maximum "B+" lead of the power unit should first be disconnected from the receiver, and a connection is then made from this terminal to the negative post of the battery. If two batteries are to be used, the negative, or "B—" terminal of the second battery should be connected with the positive post of the first, and the positive, or "B+" lead from the receiver connected with the positive terminal of this second battery.

Where a power tube of the 171A type is used in the last stage, it is imperative that a "C" battery be used, both for the sake of high quality reproduction and for economy in operation. When the maximum plate potential is 135 volts, 22.5 volts of "C" battery should be used to secure the necessary grid-bias; and when 180 volts is used on the plate, a 45-volt "C" battery is required. In view of the fact that no current whatever is drawn from batteries for biasing the grid of a tube, the "C" battery will last as long as though it were entirely disconnected from the receiver and standing idle.

For those using the older type of receivers, in which no provision is made for the use of a "C" battery, it may be said that its inclusion can best be accomplished by se-

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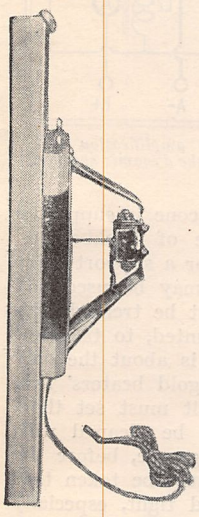
How to Build a Linen-Diaphragm Loud Speaker

Complete Details for the Construction of a Loud Speaker Which Furnishes Excellent Quality and Volume

By John M. Thompson



The side view of the double - diaphragm loud speaker; this shows how the drive unit should be mounted so that there will be no strain on the driving mechanism.

BACK in the primitive days of radio, when it was a feat worthy of strong men and true to get a station broadcasting music fifty miles distant, loud speakers were something one read about, but seldom saw. If a newcomer wanted to listen to a program, one of the headphones was detached from the headpiece and given him and then, in a very uncomfortable attitude, each sharer of the phone stopped one of his ears with his finger and tried to follow the radio entertainment with the other.

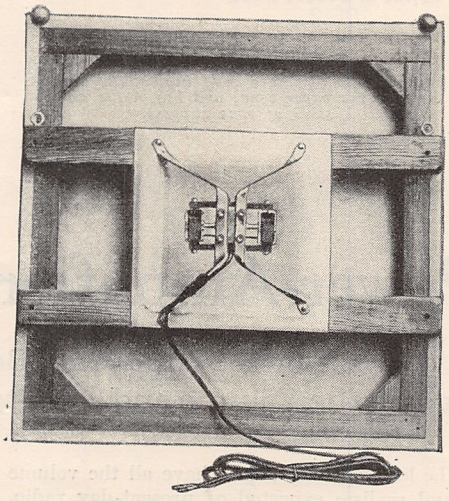
Then came a day when someone suggested that, if a phone were placed diaphragm-down near the bottom of a bowl, music could be heard all over the room—well, heard *nearly* all over the room. The truth of the matter is that, as most of us were lucky to have one tube for a detector, and audio amplification was something yet to be dreamt of, it was necessary to place an ear very close to the bowl in order to hear anything at all.

Then came the simple horns to which a headset could be clamped; then the first electrodynamic speakers, using a horn and requiring lots of power to operate; then the electromagnetic horn speakers and cones, the newer types of electrodynamic cones and, lately, the linen-diaphragm speaker.

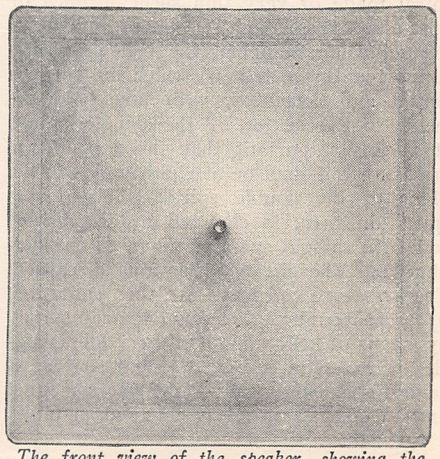
This type of speaker, an example of which was described in the March issue of RADIO NEWS, has become popular over-night with experimenters, for it is something fairly simple in construction. The frequency-range and tone quality obtainable from this speaker is remarkable and, if the constructor follows the directions presented herewith, he should have a loud speaker of which he can be proud. The total cost of that built by the writer, according to the specifications below, was under $10.

CONSTRUCTION OF FRAME

The first operation is the assembly of the wooden frame upon which the linen diaphragms are stretched. The back view of the frame, Fig. 1, shows how the various pieces of cypress or other suitable wood are cut and mortised together. This construction should be followed for, if the parts of the frame are not securely fastened by glueing, a rattle will be introduced in the speaker that cannot be eliminated without a great amount of trouble. After the pieces A and B have been glued, the corner pieces E are attached. The pieces marked C and D are next joined and screwed to the sides B, making sure that the pieces D are centered.



The 8-inch diaphragm and the unit, mounted in position, are here shown. Compare the frame work with the sketch below.



The front view of the speaker, showing the 24-inch diaphragm.

While the joints of the wooden frame are drying, the two linen diaphragms are prepared. It is necessary that a hem one-half inch wide be sewed along each side of both the large and the small squares; the one being 26 inches square and the other 8 inches.

When the joints are thoroughly dried, the large square of cloth is placed over the front of the frame, tacking down one edge; be careful to place the tacks fairly close to one another, so that there will be little danger of the cloth's pulling out. When one edge has been fastened stretch the linen as tightly as possible and tack down the opposite side. This process is repeated for the other two sides. The 8-inch square of linen is fastened to the rear frame in the same manner.

PREPARING THE DIAPHRAGM

Now locate the exact centers of both diaphragms and carefully, with the point of a compass or a sharp nail, force a hole in the linen. Be careful not to break any threads, but spread them apart until the hole is ¼-inch in diameter. Then prevail upon one of the ladies of the family to work a button-hole stitch around these two holes.

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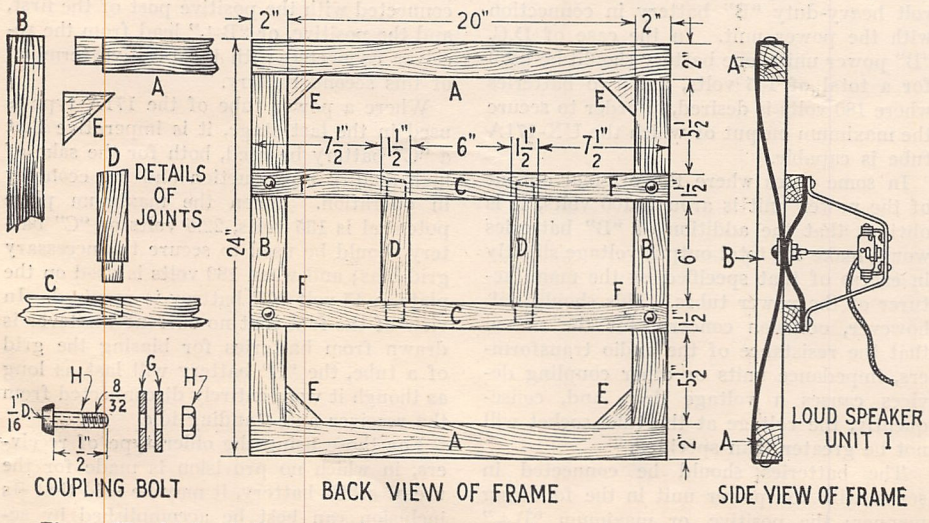
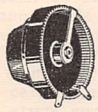
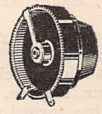


Fig. 1—The details of the construction of the wooden frames, for both the large and the small diaphragm; also, the mounting of the loud-speaker unit.

Producing R. F. Oscillations with a Buzzer



The Theory, Operation and Construction of an Oscillator Using a Buzzer Instead of a Vacuum Tube



By Emil Reisman

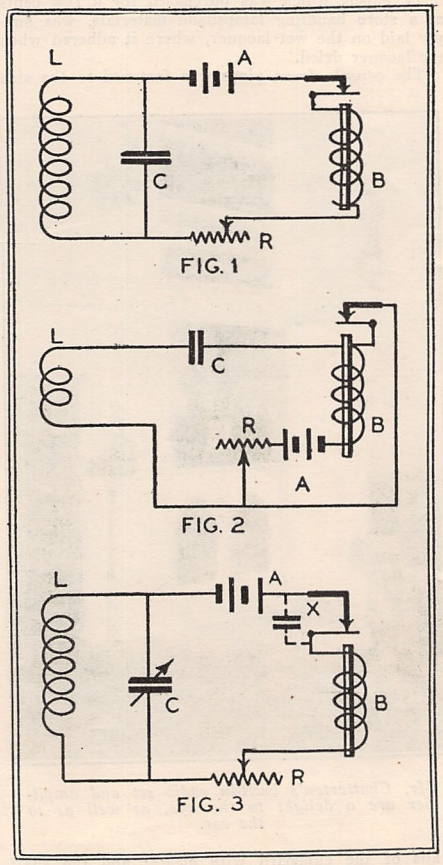
MOST radio-frequency measurements and tests require the presence of a source of radio-frequency current. The frequency or wavelength must be known accurately at all times, and in many cases this current must be modulated at audio frequencies. Such current is required in cases when it is desired to measure the capacity of a condenser, the inductance of a circuit, the wavelength of a circuit, etc. Also, a source of radio-frequency current is often very valuable, and frequently indispensable, when adjusting or testing a radio receiver; it is desirable for balancing a neutrodyne, matching the intermediate stages of a superheterodyne, adjusting a gang condenser, etc.

In a well-equipped radio laboratory the vacuum-tube oscillator is the most usual source of radio-frequency currents. In cases where the current required must be modulated, a radio-audio-frequency oscillator is used. Such apparatus is rather complicated, but is essential when precision measurements are to be made. In reality, it comprises the elements of a small radio transmitting set, and could be used as such if it were connected to an antenna.

Although vacuum-tube oscillators are absolutely essential in a laboratory, they possess certain characteristics which make them unsuited to the requirements of the average experimenter. In the first place, vacuum-tube oscillators cannot be accurately calibrated as to wavelength or frequency, and they must be checked each time with a wavemeter before they are used. This is because slight changes in either grid or plate potentials will change the frequency of the generated current. It is therefore necessary for the experimenter to have both a wavemeter and an oscillator—rather expensive equipment for home use if the instruments are to be sufficiently accurate for measuring purposes.

BUZZER METHODS

The experimenter or set builder who makes an occasional measurement, and who does not have the apparatus or time to set up a vacuum-tube oscillator, may use a high-frequency buzzer for providing a source of modulated radio-frequency oscillators. The oscillations generated by such a device are damped, but in most measurements, this is not objectionable, and in many cases it is essential. With the buzzer method it is impossible to obtain the high degree of precision that may be secured with a vacuum-tube oscillator; but the accuracy obtained is usually sufficient for all practical purposes. Also, a buzzer generator is very much easier for the beginner to operate.



Three arrangements of a satisfactory buzzer-oscillator. Fig. 3 represents that pictured in this article.

One of the most satisfactory methods of using a buzzer for the generation of radio-frequency oscillations of a definite frequency or wavelength is shown in Fig. 1. The tuned circuit is made up of the coil L and the condenser C, which are connected in shunt with each other; and the frequency to which the circuit is tuned is determined by the value of these two units. The buzzer is shown at B, the battery which operates the buzzer at A; and R is a rheostat which regulates the current passing through the buzzer. In operation, the condenser C is charged when the contacts of the buzzer B are open, closing the battery circuit; and when the contacts of the buzzer close the condenser immediately discharges through the coil L, giving rise to a train of oscillations in the circuit LC.

A careful examination of the circuit will explain the operation of the buzzer. It will be noticed that the buzzer, rheostat, battery and coil are connected in a series circuit, and that this circuit provides a path for the buzzer current. When the current starts to flow in this circuit the iron core of the buzzer becomes magnetized, because of the current flowing through the winding. The vibrator or contact arm of the buzzer is attracted to the core by the magnetic force and this opens the battery circuit. When the battery circuit is opened the iron core of the buzzer loses its magnetism and as a result the spring causes the contact arm to return to its original position. This operation allows current to pass through the circuit again and the operation is repeated. In the case of a high-frequency buzzer the contact arm of the buzzer may vibrate fast enough to produce a note having a frequency of 500 cycles.

Another form of generator for radio-frequency oscillations is illustrated in Fig. 2. A circuit of this type produces highly-damped oscillations; but the frequency or wavelength is not dependent upon the circuit LC, as in the case of the oscillator illustrated in Fig. 1. C is a fixed condenser having a capacity of 2 mf., and L is a coil of 2 or 3 turns of wire. When measurements are made with an instrument of this type the coil is closely coupled to the circuit which is to be measured and, as the oscillations in circuit LC are highly damped, the oscillatory circuit coupled to L will be

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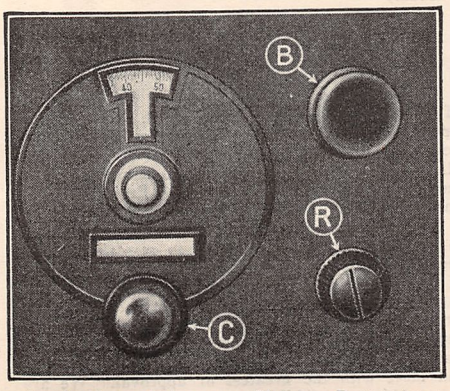
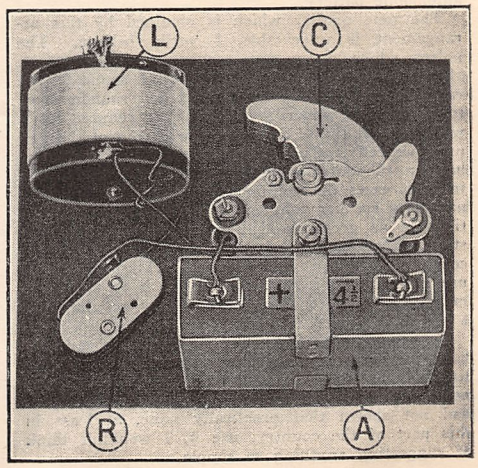


Panel view of buzzer-oscillator. B, buzzer; R, variable-resistance control; and C, control for variable condenser.



The rear view of the panel opposite. L, inductor; C, condenser; R, variable resistor; and A, 4½-volt battery.

Letters from Home Radio Constructors

ONE A.F. STAGE ENOUGH

Editor, RADIO NEWS:

I get so many helpful pointers from your excellent magazine that I am moved to pass out a little advice which I hope may be helpful to some of your readers. Now that the attention of so many has turned to the development of tone quality and exact reproduction, it seems to me that the majority of home set builders are overlooking the most simple and most effective means of bringing out the low tones in all their fullness and the high ones without noticeable flattening.

With the advent of the power tubes the radio set came to have possibilities of becoming a real musical instrument; and for their advent may Allah be praised. I will describe the changes I have made in the last set I built; and, since the changes would not be practical in some types of sets, it will become evident to the owners of these types at once. I built a five-tube tuned-radio-frequency outfit, using the Freshman Masterpiece kit of coils and condensers. In most circuit diagrams which have come to my attention, the filaments of both the R.F. tubes and that of the detector tube are controlled by a single rheostat. I have introduced a separate rheostat to control the detector. This change is very important if the maximum clarity is to be obtained.

I provided a separate "B" battery lead for the R.F. stages, as well as one for each of the audio stages. Directions with most circuits which I have seen show 90 as the proper voltage on the R.F. tubes. My experiments have shown that a voltage of less than 45 gives the best tone quality and does not lower the volume noticeably. I use the detector voltage output on the "B" unit for both the detector and the R.F. stages. This is "change" number two.

My set is being operated in Detroit, where there are three or four high-powered stations. On such stations as WTAM, WGY, KOA, KDKA, WBBM, WCCO, WOR, etc., the voltage should go up to about sixty-seven on the R.F. stages. But change number three is the most important and is equally as simple. Having a separate "B" lead for the first stage of audio frequency, it is easy to place a CX-371 power tube in its socket and to apply 180 volts (providing you have a suitable "B" unit) to its plate. Arrangement must, of course, be made for around 40 volts of "C" battery for this tube. The second stage of audio amplification is not used, of course. And this is the last of the necessary changes.

There are certain requisites, however, which are very essential, I believe. The first is a power unit; very few would attempt to use dry batteries with such a drain, I suppose. The next requisite is a good speaker, preferably the heavy-duty type (I use the Western Electric 17-inch cone). The transformer used in my own set has a very great deal to do with its clarity, I am sure. I used the General Radio Co. combination for first and second stages of audio. The last requisite, and not the least important, is a very good ground. Again, however, if a storage battery is used for the filament supply, the use of the small 80- to 100-hour radio battery is not satisfactory. I have both the 120-hour automobile battery and this type, and have experimented with each of them. I find that the tone and volume, using a smaller battery with the arrangement described above, does not compare with that which may be had with the use of the automobile battery.

The tone quality which is obtained by this arrangement is unbeatable, I verily believe. The noises which a two-step amplifier introduces are absolutely gone. In fact, it doesn't sound like a radio at all. The same fullness and roundness of tone is there when the volume is reduced to a whisper, and the R.F. rheostat will control the volume perfectly. Curiously enough, the best tone is had on the outside stations mentioned above, and in most cases the volume is greater than the ordinary loud-speaker volume. The volume on local stations is as great as that from the ordinary two-steps without power tube, and the clarity cannot be compared. When it is desired, while tuning, to use both steps of A.F. in the set it is simple to make the required changes and they require only a second.

It is a source of much wonderment to me why home set builders as well as others with manufactured sets (where the changes are practical) are not using this arrangement; and if my experience had not shown that practically none, at least in this part of the country, use it, I wouldn't think of suggesting anything so simple.

ERROL L. GREEN,
3773 Tuxedo Avenue, Detroit, Michigan.

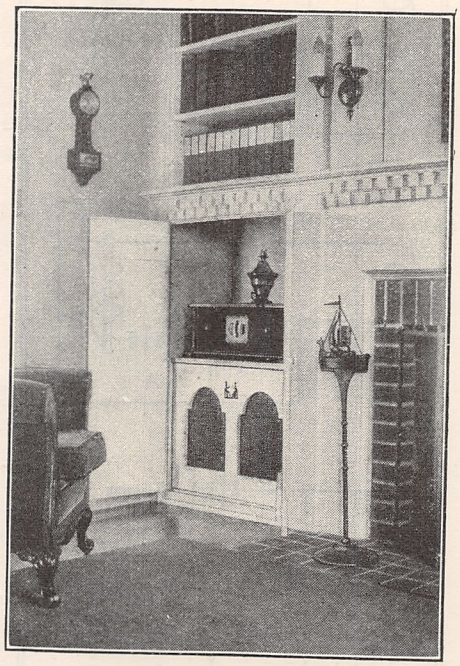
MAKING RADIO DECORATIVE

Editor, RADIO NEWS:

The science of radio having now reached a stage of development where its application in the form of radio reproducing instruments is more or less standardized, the amateur begins to turn his attention to the *art of radio.* The cry of yesterday for "selectivity and volume" having been appeased, the demand today is for "beauty and tone quality." Here opens a new field as fascinating as the first, for those who like to make things.

It need not be difficult or costly to give almost any radio a good setting, suitable to the most discriminating. The installation depicted in the accompanying illustration was made with little effort and at small expense. To construct the front of the console compartment, two bread boards were used. The openings were cut out with a ten-cent scroll saw, and the boards were then cleated together at the rear. After the front had been sanded down and painted with lacquer a piece of green-gold silk cloth was glued across the two openings at the back. This shade of cloth gives a shadow effect that is quite inconspicuous. The silhouette of glazed black paper, which was purchased for a few cents at a store handling lampshade materials, was simply laid on the wet lacquer, where it adhered when the lacquer dried.

The console front piece was fastened to the side



Mr. Chatterton's built-in radio set and amplifier are a delight to the eye, as well as to the ear.

walls of the cupboard with cleats; and the shelf was placed loosely above the front piece, so that the shelf board can be moved back and forth to allow of attaching the wires at the rear of the cupboard. The console compartment was lined with "Balsam Wool" to absorb echoes.

The set, in this instance, is a modified Browning-Drake employing all dry-cell tubes, with a power tube and high-quality transformer audio amplifiers. The "C" batteries are contained in the plain walnut set cabinet and the dry-cell "A" batteries are placed on the shelf at the rear of the cabinet, where they are out of sight, and yet convenient to reach for changing. The console compartment contains the heavy-duty "B" batteries and a home-made "ortho"-type horn speaker in series with a cone speaker. The upholstered chair placed in front of the installation helps to improve the tone.

When the cupboard doors are closed the whole outfit is entirely concealed from view, as well as protected from dust and molestation.

G. A. CHATTERTON,
Lakewood, Madison, Wis.

HOW LONDON REALLY CALLS

Editor, RADIO NEWS:

I am glad to report to you that with a home-built short-wave receiver (following the circuit you published in October, 1927), London, England, is received practically every day. They do not seem to transmit on Saturdays and Sundays. No one who who has heard the real thing could be fooled in the manner of your story in the March number, "This is Station 2LO, London, England," *for the announcements never include the call letters.* They say simply, "London calling," or "London is calling." I set my watch by Big Ben, and so have Greenwich time direct. The program starts at 2 p. m. (E. S. T.) with chimes of Big Ben and the clock striking seven.

At times I can hear it faintly on the loud speaker; with the phones the concerts are worth listening to. Dance music seems to be reserved as an extra from Daventry from 11 to 12 (Greenwich time). I think, judging from the character of the music sent out, that Roxy's Saturnalia would last about one night.

Instead of transformers, I use three stages of resistance amplification. I find that a 200 tube is far superior to anything else as a detector.

I have read RADIO NEWS consistently and know that when any advance worth knowing is made in radio you will be among the first to publish it. For instance, you published the Everyman Circuit a year before another paper brought it out and featured it.

I thank you for the short-wave circuit, for it seems wonderful to me that I can sit down and really enjoy day by day the programs from London. I hope, though, this circuit does not become too popular, for the combined squeals and howls caused by inexperienced operators would put a blanket on "London calling."

Another thing, if a law was passed prohibiting jazz until after 11 p. m. each day, the interference problem would be solved; for a lot of stations would have to close down, having nothing to broadcast. Moreover, it should be made illegal for announcers and Roxy to laugh at their own jokes, on the grounds of using the air for false pretenses and the hollow and unnatural character of most of the laughs, or guffaws.

I had this letter in the envelope sealed, ready to mail; but opened it to tell you that the reception from London this evening (February 28) was remarkable. I put on one stage of transformer A.F. to above and the dance program from the Hotel Carlton was heard with fine volume on the loud speaker. The program finished with Big Ben striking midnight.

STANLEY C. PAGE,
King Ferry, New York.

PATIENCE AND PERSEVERANCE

Editor, RADIO NEWS:

I want to congratulate you on such a remarkable hook-up as the Qualitone Six. Being one of just ordinary radio knowledge, I was rather dubious about attempting it. During the time I was balancing it, I was ready to give everybody a good cussing. The instructions say twenty minutes to balance; it took me about twenty hours. Nevertheless, it is now balanced and I hear stations I never heard before.

I have had it in operation, and have logged seventy stations, among them PWX, Havana. It is a great pleasure to sit down and listen to some of these 50- and 100-watt stations. I only made one substitution, that being in the use of Amsco variable condensers. When you make a better set, let me know.

L. C. BRADFORD,
(Kentucky)

(*Unfortunately, copies of the October,* 1927, *issue of* RADIO NEWS, *describing this set, are not available, so that this office cannot supply them; and we omit Mr. Bradford's address, so that too many readers will not ask to borrow his copy.*—EDITOR.)

THE PERIDYNE MAKES A HIT

Editor, RADIO NEWS:

I have built some fifteen hundred different types of receiving sets, including the "Hot Spot 14;" but up to date, I have never built a machine that has developed such wonderful efficiency, with such simplicity in construction, with such a marked improvement over an old design, as your "Peridyne Five" has proven.

The clarity of reception that we have been able to obtain with this machine is so remarkable, and the compliments of my friends and associates, some of whom are highly developed technically in radio, has prompted me to take this liberty to write this letter of congratulation to you. And I can honestly state that this machine can be placed beside any make of radio, either commercial or amateur-built, and meet with the greatest of approval. We are now making an "ABC" power pack, to eliminate the batteries, and to operate from lighting circuit.

When this machine is put into a console cabinet

Letters from Home Radio Set Constructors

I will try to send you a photograph of it, as I am very proud of this set. Thanking you for your publication of this set, and extending to you the good wishes of my associates and set builders, I am,

Yours very truly,
J. G. PETTIS,
Okolona, Mississippi.

FROM "DOWN UNDER"

Editor, RADIO NEWS:

Last October I built the 18-1500-meter receiver described in July, 1927, RADIO NEWS, and it is "the goods." I might first state that it is the first and only set I have ever built or operated. I would have written sooner; but I wanted to give this little 3-tuber a fair test in midsummer. (*Mid-summer in Australia comes during the months of a northern mid-winter*—EDITOR.) Instead of .00035-mf. condensers, I fitted two 17-plate Pilots; and the total cost of components was under £13 ($65). At present I have only the one coil form, covering from 180 to 550 meters; I could not procure the standard coils specified, so made one. I have a 15-shilling British speaker unit on the gramophone tone arm, and the volume would surprise you. I have been told that it has been heard up to 1500 yards away; and I have heard it myself quite plainly—in fact, every word of a song, at a distance of 200 yards.

LETTERS for this page should be as short as possible, for so many are received that all cannot be printed. Unless a set is made from a published description, a schematic sketch should be sent; photos can be used only to illustrate a novelty, and then only if large and very clear. Inquiries for information not given here should be sent to the constructor direct; but he should NOT be asked to furnish data already published, here or elsewhere.

This department is for free discussion to the extent that space permits; but RADIO NEWS accepts no responsibility for the opinions of readers as to the relative merits of apparatus and circuits.

I have tuned in and clearly heard amateurs working on only 13 and 28 watts, 750 miles away. I have had one amateur on 50 watts at 600 miles, with good loud-speaker volume and excellent tone. 2YA, New Zealand, 1,700 miles and KZRM, Manila (Philippine Islands) on the phones at nearly 4,000 miles; last Saturday night I heard every round of the fights. Not bad on the broadcast band with three tubes in midsummer. I am using three Radiotrons and Columbia dry cells and find the set very economical to operate and easy to tune.

I must sincerely thank your splendid journal for having offered its readers such a wonderful little three-tube set. I get better results than four- and five-tube sets. My aerial is a single strand of Belden wire, 63 feet high.

My location is central west in New South Wales, on the Western railroad near Dubbo, 280 miles west of Sydney. My nearest class A stations are 2FC and 2BL at Sydney. I trust you will be interested and wish RADIO NEWS every success.

HILTON SAUNDERS,
"Kia Ora," Wongarbon, New South Wales, Australia.

(*Continued on page* 1293)

List of Broadcast Stations in the United States

(*Continued from page* 1220)

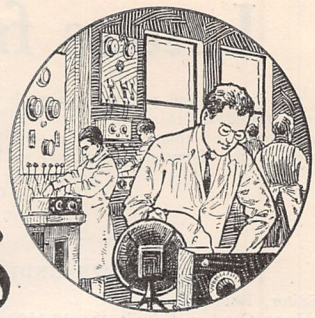
Radio Call Letter	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
WJBU	Lewisburg, Pa.	214	100
WJBW	New Orleans, La.	238	30
WJBY	Gadsden, Ala.	234	50
WJBZ	Chicago Heights, Ill.	208	100
WJJD	Mooseheart, Ill.	**366	1000
WJKS	Gary, Ind.	232	500
WJPW	Ashtabula, Ohio	208	30
WJR-WCX	†Pontiac, Mich	441	5000
	(Also 32 meters, 75 watts)		
WJZ	†New York, N. Y.	**454	30,000
	(3XL, 59.96 meters, 30 k.w.)		
WKAQ	San Juan, Porto Rico	322	500
WKAR	East Lansing, Mich.	278	*500
WKAV	Laconia, N. H.	224	50
WKBB	Joliet, Ill.	216	150
WKBC	Birmingham, Ala.	219	10
WKBE	Webster, Mass.	229	100
WKBF	Indianapolis, Ind.	252	250
WKBG	Chicago, Ill. (portable)	201	100
WKBH	La Crosse, Wis.	220	500
WKBI	Chicago, Ill.	216	50
WKBL	Monroe, Mich.	205	15
WKBN	Youngstown, Ohio	214	50
WKBO	Jersey City, N. J.	219	500
WKBP	Battle Creek, Mich.	213	50
WKBQ	New York, N. Y.	219	500
WKBS	Galesburg, Ill.	217	100
WKBT	New Orleans, La.	252	50
WKBV	Brookville, Ind.	217	100
WKBW	Buffalo, N. Y.	217	5000
WKBZ	Ludington, Mich.	200	15
WKDR	†Kenosha, Wis.	248	15
WKEN	Amherst, N. Y.	204	750
WKJC	Lancaster, Pa.	252	50
WKRC	Cincinnati, Ohio	246	500
WKY	Oklahoma City, Okla.	288	150
WLAC	Nashville, Tenn.	225	1000
WLAP	Louisville, Ky.	268	*30
WLB	Minneapolis, Minn.	246	500
WLBC	Muncie, Ind.	210	50
WLBF	Kansas City, Mo.	210	50
WLBG	Petersburg, Va.	214	100
WLBH	Farmingdale, N. Y.	232	30
WLBI	East Wenona, Ill.	238	250
WLBL	†Stevens Point, Wisc.	333	*1000
WLBM	Cambridge, Mass.	231	50
WLBN	Chicago, Ill. (portable)	204	50
WLBO	Galesburg, Ill.	217	100
WLBQ	Atwood, Ill.	219	25
WLBR	Rockford, Ill.	248	15
WLBT	Crown Point, Ind.	248	50
WLBV	Mansfield, Ohio	207	50
WLBW	Oil City, Pa.	294	500
WLBX	Long Island City, N.Y.	204	250
WLBY	Iron Mountain, Mich.	210	50
WLBZ	Dover-Foxcroft, Me.	208	250
WLCI	Ithaca, N. Y.	248	50
WLEX	Lexington, Mass.	216	50
WLIB	See WGN		
WLIT	Philadelphia, Pa.	405	500
WLOE	Chelsea, Mass.	211	100
WLS	†Chicago Ill.	**345	5000
WLSI	See WDWF		
WLTH	Brooklyn N Y.	256	250
WLTS	Chicago Ill.	484	100
WLW	†Cincinnati Ohio	428	5000
	(Also 52.02-49.96 meters 250 watts)		
WLWL	†Kearny, N. J.	370	5000
WMAC	Cazenovia, N. Y.	225	500
WMAF	So. Dartmouth, Mass.	428	500
WMAK	*Martinsville, N. Y.	545	750
WMAL	Washington, D. C.	242	500
WMAN	Columbus, Ohio	234	50
WMAQ	*Chicago, Ill.	**447	*2500
WMAY	St. Louis, Mo.	234	100
WMAZ	Macon, Ga.	270	500
WMBA	Newport, R. I. (port.)	204	100
WMBB	†Chicago, Ill.	252	5000
WMBC	Detroit, Mich.	244	100
WMBD	Peoria Heights, Ill.	205	250
WMBE	St. Paul, Minn.	208	10
WMBF	Miami Beach, Fla.	384	500
WMBG	Richmond, Va.	220	50
WMBH	Joplin, Mo.	204	100
WMBI	†Chicago, Ill.	**263	5000
WMBJ	McKeesport, Penna.	232	50
WMBL	Lakeland, Fla.	229	100
WMBM	Memphis, Tenn.	210	10
WMBO	Auburn, N. Y.	220	100
WMBQ	Brooklyn, N. Y.	204	100
WMBR	Tampa, Fla.	252	100
WMBS	Lemoyne, Pa.	234	250
WMBW	Youngstown, Ohio	214	50
WMC	Memphis, Tenn.	517	500
WMCA	†New York, N. Y.	370	500
WMES	Boston, Mass.	211	50
WMPC	Lapeer, Mich.	234	30
WMRJ	Jamaica, N. Y.	207	10
WMSG	New York, N. Y.	236	500
WNAC-WBIS	Boston, Mass.	461	500
WNAD	Norman, Okla.	240	500
WNAL	Omaha, Neb.	258	250
	(Also 105 meters, 50 watts)		
WNAT	Philadelphia, Pa.	288	100
WNAX	Yankton, S. D. (day)	303	1000
WNBA	Forest Park, Ill.	208	200
WNBF	Endicott, N. Y.	207	50
WNBH	New Bedford, Mass.	261	250
WNBJ	Knoxville, Tenn.	207	50
WNBO	Washington, Pa.	211	15
WNBQ	Rochester, N. Y.	205	15
WNBR	Memphis, Tenn.	229	100
WNBT	Elgin, Ill. (time sigs.)	35.5	500
WNBW	Carbondale, Pa.	209	5
WNBX	Springfield, Vt.	242	10
WNBZ	Saranac Lake, N. Y.	232	10
WNJ	Newark, N. J.	268	250
	(Has short-wave transmitter)		
WNOX	Knoxville, Tenn.	265	1000
WNRC	Greensboro, N. C.	224	250
WNYC	New York, N. Y.	526	500
WOAI	San Antonio, Tex.	500	5000
WOAN	Lawrenceburg, Tenn.	240	500
WOAX	Trenton, N. J.	240	500
WOBR	Shelby, Ohio (portable)	204	10
WOBT	Union City, Tenn.	205	15
WOBU	Charleston W. Va.	268	50
WOC	Davenport, Iowa	375	5000
WOCL	Jamestown, N. Y.	224	25
WODA	Paterson, N. J.	294	1000
WOI	Ames, Iowa	265	*1000
WOK	See WMBB		
WOKO	Beacon, N. Y.	216	500
WOKT	Rochester, N. Y.	210	500
WOMT	Manitowoc, Wis.	222	100
WOO	Philadelphia Pa.	349	500
WOOD	†Grand Rapids, Mich.	261	500
WOQ	Kansas City, Mo.	341	500
WOR	†Kearny, N. J.	422	5000
	(Also 65.4 meters, 50 watts)		
WORD	†Batavia, Ill.	252	5000
WOS	Jefferson City, Mo.	422	500
WOW	Omaha, Nebr.	508	1000
WOWO	Fort Wayne, Ind.	229	*2500
	(Also 22.8 meters, 1000 watts)		
WPAP	See WQAO		
WPCC	Chicago, Ill.	224	500
WPCH	†New York, N. Y.	326	500
WPEP	Waukegan, Ill.	216	250
WPG	Atlantic City, N. J.	273	5000
WPRC	Harrisburg, Pa.	210	100
WPSC	State College, Pa. (day)	300	500
WPSW	Philadelphia, Pa.	207	50
WPTF	Raleigh, N. C.	545	500
WQAM	Miami, Fla.	384	750
WQAN	Scranton, Pa.	231	250
WQAO-WPAP	†Cliffside, N. J.	395	500
WQBA	Tampa, Fla.	238	250
WQBC	Utica, Miss. (day)	216	225
WQBJ	Clarksburg, W. Va.	240	65
WQBZ	Weirton, W. Va.	250	60
WQJ	Chicago, Ill.	447	500
WRAF	Laporte, Ind.	208	100
WRAH	Providence, R. I.	200	250
	(Has short-wave transmitter)		
WRAK	Escanaba, Mich.	283	50
WRAM	Galesburg, Ill.	248	50
WRAW	Reading, Pa.	238	100
WRAX	Philadelphia, Pa.	213	250
WRBC	Valparaiso, Ind.	238	250
WRC	Washington, D. C.	**468	500
WREC	†Memphis, Tenn.	250	100
WREN	Lawrence, Kan.	254	750
WRES	Quincy, Mass.	217	50
WRHF	Washington, D.C. (day)	322	150
WRHM	†Minneapolis, Minn.	261	1000
WRM	Urbana, Ill.	273	*500
WRK	Hamilton, Ohio	205	100
WRMU	New York, N.Y. (port.)	201	100
	(2XAO, ship, 105.9 meters, 100 watts)		
WRNY	†New York, N. Y.	326	500
	(Also 30.91 meters, 500 watts)		
WRPI	Terre Haute, Ind.	208	100
WRR	Dallas, Tex.	461	500
WRRS	Racine, Wis.	248	50
WRST	Bay Shore, N. Y.	211	250
WRUF	Gainesville, Fla.	203	5000
WRVA	Richmond, Va.	254	1000
WSAI	†Cincinnati, Ohio	361	5000
WSAJ	Grove City, Pa.	224	250
WSAN	Allentown, Pa.	222	100
WSAR	Fall River, Mass.	213	250
WSAX	Chicago, Ill. (port.)	204	100
WSAZ	Huntington, W. Va.	250	100
WSB	Atlanta, Ga.	476	1000
WSBC	Chicago, Ill.	232	500
WSBF	St. Louis, Mo.	258	250
WSBT	South Bend, Ind.	400	500
WSDA	See WSGH		
WSEA	Portsmouth, Va.	263	500
WSGH	Brooklyn, N. Y.	227	500
WSIX	Springfield, Tenn.	250	150
WSKC	Bay City, Mich.	273	250
WSM	Nashville, Tenn.	337	5000
WSMB	New Orleans, La.	297	750
WSMK	Dayton, Ohio	297	200
WSPD	Toledo, Ohio	240	250
WSRO	Middletown, Ohio	236	100
WSSH	Boston, Mass.	288	100
WSUI	Iowa City, Ia. (day)	476	500
WSUN	St. Petersburg, Fla.	517	750
WSVS	Buffalo, N. Y.	204	50
WSYR	Syracuse, N. Y.	294	500
WTAD	Quincy, Ill.	236	*250
WTAG	Worcester, Mass.	517	250
WTAM	Cleveland, Ohio	**400	*3500
WTAQ	Eau Claire, Wis.	254	500
WTAR-WPOR	Norfolk, Va.	236	500
WTAS	Elgin, Ill.	275	500
WTAW	College Station, Tex.	484	500
WTAX	Streator, Ill.	248	50
WTAZ	Richmond, Va.	220	15
WTFF	Mt. Vernon Hills, Va.	203	10,000
WTFI	Toccoa, Ga.	210	250
WTHS	Atlanta, Ga.	227	200
WTIC	Hartford, Conn.	535	500
WTMJ	Milwaukee, Wis.	294	1000
WTRL	Midland Park, N. J.	207	15
WWAE	Chicago, Ill.	227	500
WWJ	Detroit, Mich.	353	1000
WWL	New Orleans, La.	246	500
WWNC	Asheville, N. C.	297	1000
WWRL	†Woodside, N. Y.	200	100
WWVA	Wheeling, W. Va.	517	250

*Allowed higher daylight power. **Standard or constant-frequency transmission. †Remote Control.

LIST OF CANADIAN BROADCAST CALLS

CFAC	Calgary, Alta.	435	500
CFCA	Toronto, Ont.	357	500
CFCF	Montreal, Que.	411	1650
CFCH	Iroquois Falls, Ont.	500	250
CFCN	Calgary, Alta.	435	1800
CFCQ	Vancouver, B. C.	411	10
CFCT	Victoria, B. C.	476	250
CFCY	Charlottetown, P.E.I.	312	100
CFGC	Brantford, Ont.	297	50
CFJC	Kamloops, B. C.	268	15
CFLC	Prescott, Ont.	297	50
CFMC	Kingston, Ont.	268	20
CFNB	Fredericton, N. B.	248	25
CFQC	Saskatoon, Sask.	330	500
CFRB	Toronto, Ont.	517	1000
CFRC	Kingston, Ont.	268	500
CFYC	Burnaby, B. C.	411	500
CHCA	Calgary, Alta.	435	250
CHCS	Hamilton, Ont.	341	10
CHCT	Red Deer, Alta.	357	1000
CHCY	Edmonton, Alta.	517	250
CHGS	Summerside, P. E. I.	268	25
CHIC	Toronto, Ont.	357	500
CHMA	Edmonton, Alta.	517	250
CHMI	Mt. Hamilton, Ont.	341	50
CHNC	Toronto, Ont.	357	500
CHNS	Halifax, N. S.	322	100
CHPC	Vancouver, B. C.	411	1000
CHRC	Quebec, Que.	341	5
CHSC	Unity, Sask.	268	50
CHUC	Saskatoon, Sask.	330	500
CHWC	Regina, Sask.	312	15
CHWK	Chilliwack, B. C.	248	5
CHYC	Montreal, Que.	411	750
CJBC	Toronto, Ont.	357	500
CJBR	Regina, Sask.	312	500
CJCA	Edmonton, Alta.	517	500
CJCJ	Calgary, Alta.	435	250
CJCR	Red Deer, Alta.	357	1000
CJGC	London, Ont.	330	500
CJGX	Yorkton, Sask.	476	500
CJOC	Lethbridge, Alta.	268	50
CJOR	Sea Island, B. C.	291	50
CJRM	Moose Jaw, Sask.	297	500
CJSC	Toronto, Ont.	357	500
CJWC	Saskatoon, Sask.	330	250
CJYC	Toronto, Ont.	517	500
CKAC	Montreal, Que.	411	1200
CKCD	Vancouver, B. C.	411	1000
CKCI	Quebec, Que.	341	23
CKCK	Regina, Sask.	312	500
CKCL	Toronto, Ont.	357	500
CKCQ	Ottawa, Ont.	435	100
CKCR	St. George, Ont.	258	25
CKCV	Quebec, Que.	341	50
CKCX	Toronto, Ont.	517	500
CKFC	Vancouver, B. C.	411	50
CKGW	Bowmanville, Ont.	312	5000
CKLC	Red Deer, Alta.	357	1000
CKMC	Cobalt, Ont.	248	5
CKNC	Toronto, Ont.	357	500
CKOC	Hamilton, Ont.	341	100
CKOW	Toronto, Ont.	517	500
CKPC	Preston, Ont.	248	8
CKPR	Midland, Ont.	268	50
CKSH	St. Hyacinth, Que.	312	50
CKSM	Toronto, Ont.	291	1000
CKUA	Edmonton, Alta.	517	500
CKWX	Vancouver, B. C.	411	50
CKY	Winnipeg, Man.	384	500
CNRA	Moncton, N. B.	322	500
CNRC	Calgary, Alta.	435	500
CNRE	Edmonton, Alta.	517	500
CNRM	Montreal, Que.	411	1650
CNRO	Ottawa, Ont.	435	500
CNRO	Quebec, Que.	341	50
CNRR	Regina, Sask.	312	500
CNRS	Saskatoon, Sask.	330	500
CNRT	Toronto, Ont.	357	500
CNRV	Vancouver, B. C.	291	500
CNRW	Winnipeg, Man.	384	500

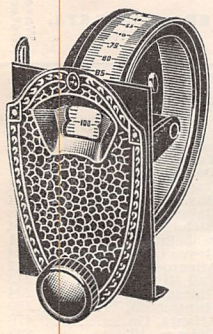
Radio News Laboratories



RADIO manufacturers are invited to send to RADIO NEWS LABORATORIES *samples of their products for test. It does not matter whether or not they advertise in* RADIO NEWS, *the* RADIO NEWS LABORATORIES *being an independent organization, with the improvement of radio apparatus as its aim. If, after being tested, the instruments submitted prove to be built according to modern radio engineering practice, they will each be awarded a certificate of merit; and that apparatus which embodies novel, as well as meritorious features in design and operation, will be described in this department, or in the "What New in Radio" department, as its news value and general interest for our readers shall deserve. If the apparatus does not pass the Laboratory tests, it will be returned to the manufacturer with suggestions for improvements. No "write-ups" sent by manufacturers are published in these pages, and only apparatus which has been tested in the Laboratories and found of good mechanical and electrical construction is given a certificate. As the service of the* RADIO NEWS LABORATORIES *is free to all manufacturers, whether they are advertisers or not, it is necessary that all goods to be tested be forwarded prepaid, otherwise they cannot be accepted. Apparatus ready for, or already on, the market will be tested for manufacturers free of charge. Apparatus in process of development will be tested at a charge of $2.00 per hour required to do the work. Address all communications and all parcels to* RADIO NEWS LABORATORIES, *230 Fifth Avenue, New York City.*

DRUM DIAL

The drum dial shown here has a very attractive appearance and is a neat piece of mechanical workmanship; strong, light, precise in operation and easy to install. The motion of the controlling knob at the lower end of the little front panel is transmitted to the drum through a system of four pulleys and a soft flexible cord; the vernier

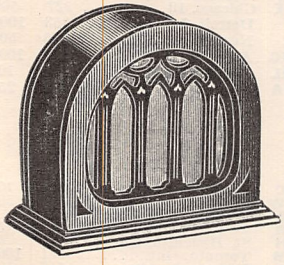


ratio is approximately 1:9. The scale of the dial is approximately 1⅜-inch wide and evenly calibrated from 0 to 200. It is translucent and illuminated from within by a small 6-volt bulb, operated from the filament-supply source.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2114.

CONE REPRODUCER

A combination of refinement in appearance and excellence in reproduction is exemplified in the loud speaker shown here. This instrument is of the cone type and has a speaker unit of floating-armature construction. The paper cone, 7½ inches in diameter, is glued to a kid-leather

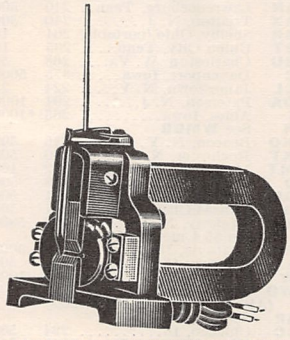


ring which is, in turn, attached to the metal frame carrying the speaker unit. This frame takes the shape of a truncated cone, and is lined with a thin felt. The speaker unit is a model of mechanical perfection and neatness; the windings are completely enclosed by the pole pieces and by two cast aluminum shells. The vibrating armature is indirectly, through a lever system, connected to the cone. The graceful housing is of two-tone walnut, and lined with heavy felt to prevent undesirable reflection of tones; the speaker is equipped with a built-in filter.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2117.

LOUD-SPEAKER UNIT

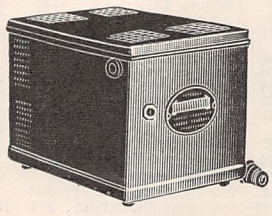
A detailed description of the excellent loud-speaker unit shown here was given in the April issue of RADIO NEWS (page 1149) in connection with that of the loud speaker to which Certificate of Merit No. 2278 was issued.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2300.

"A-B" POWER SUPPLY

A combination of an "A" and "B" power-supply unit in one hous-

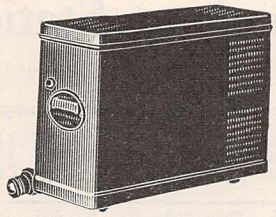


ing is shown here. The "A" unit is that described separately as No. 2304; the "B" power unit has a gas-filled full-wave rectifier tube and supplies, through the binding posts mounted on the bakelite panel inside the housing, four different voltages, one for the detector and three for the different amplifying stages. The output voltages may be varied within very wide ranges by operating the two adjustable resistors mounted on the same panel. An output of approximately 30 milliamperes at 180 volts has been measured. The iron housing is 8 x 10 x 12 inches and has a brown crystalline finish.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2302.

"A" POWER UNIT

This "A" power supply unit is built of the components used in the

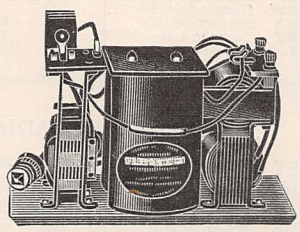


kit described below, and has the same operating characteristics. It is enclosed in an iron container, having a brown crystalline finish.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2303.

"A" POWER-SUPPLY KIT

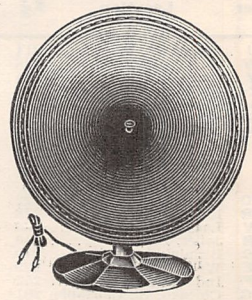
The assembled kit shown here operates from the 110-volt 50-60-cycle house-lighting line. It consists of a step-down transformer, a rectifier of the dry (copper-oxide) type, two large low-resistance choke coils and two dry-electrolytic condensers of extremely large capacity. The secondary of the step-down transformer is tapped, a fact which makes it possible to adjust the power unit to the different line voltages found under operating conditions. This unit has been found capable of delivering 2½ amperes at approximately 5.5 volts, an output which meets the requirements of almost any commercial radio receiver; the current supplied is satisfactory in quality. A detailed description of the dry-electrolytic condensers, used in this kit, is given elsewhere in this issue; see the "What's New in Radio" department.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2304.

LOUD SPEAKER

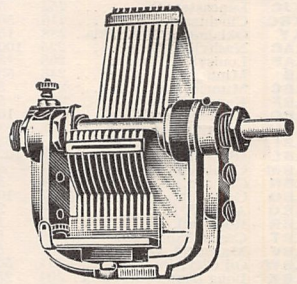
This reproducer is of the double-cone type; the paper diaphragm is approximately 22 inches in diameter. The speaker unit is of good mechanical and electrical design; it is of the balanced-armature type and has laminated pole-pieces of silicon steel. The connection between the cone and the vibrating armature is effected through a lever system. A small condenser (approximately .05-mf. capacity) is connected across the speaker coils of the unit. This instrument has been found a very good reproducer with regard to quality and volume.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2305.

VARIABLE CONDENSER

This condenser is of excellent electrical and mechanical design, and

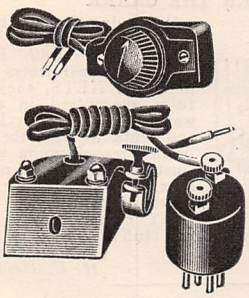


has a remarkably fine finish. It has a sturdy stator frame made of nickel-plated cast iron, which is drilled to give a choice of baseboard and panel mounting. The stator plates are soldered to the mounting and spacing bars and the plates of the rotor to the shaft and to one spacing bar. Both rotor and stator are silver-plated. The floating shaft may be removed, so that several of these condensers may be operated in gang, using a common shaft. This 23-plate condenser has a maximum capacity of approximately 450 mmf., and a minimum capacity of 25 mmf; its plates are of a shape such as to secure the most even distribution of the broadcasting stations along the dial. It is a French product.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2307.

PHONOGRAPH PICK-UP

The phonograph pick-up shown consists of three separate parts, the pick-up unit proper, the socket plug or adapter, and the volume control. The pick-up unit is of the conventional electro-magnetic balanced-armature type; it has a powerful horseshoe magnet and laminated pole pieces, and is enclosed in a nickeled case which is very easily attached to any phonograph. The adapter fits in any standard UX socket and for operation is inserted into the socket

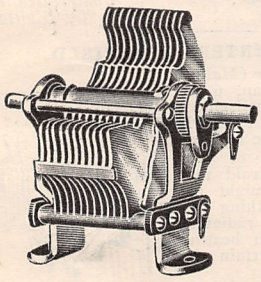


of the detector tube. The two binding posts on top of the adapter serve to connect the leads of the pick-up unit and those of the volume control to the plate and filament prongs of the detector, through a built-in 0.25-mf. condenser. The reproduction from phonograph records by means of this pick-up, when operated in connection with a well built radio receiver, has been found to be very satisfactory.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2308.

VARIABLE CONDENSER

This 24-plate variable condenser has a maximum capacity of approximately 490 mmf., and a minimum of approximately 22 mmf.; its characteristic curve is very close to that of the straight-line-wavelength. The stator and rotor plates are not flat,

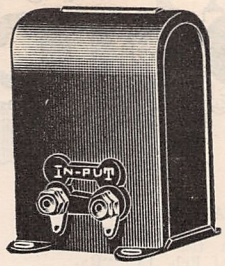


but are concentrically corrugated. This condenser can be mounted either on the front panel, through a single hole, or on the baseboard; in either case, the rotor may turn either clockwise or counter-clockwise. The condenser shaft is fastened to the rotor by a set-screw, and may be removed and replaced by a longer shaft to make possible gang mounting of several instruments.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2309.

OUTPUT FILTER

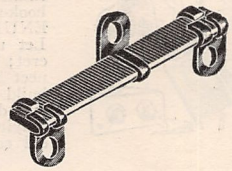
This output filter is designed to protect the windings of a loud-speaker unit from burning out, by preventing the flow through them of the heavy D. C. component of the plate current of the power tube used in the last stage. It consists of a choke coil and a condenser, both enclosed in a neat metallic case. The coil has an ohmic resistance of approximately 670 ohms and an inductance of approximately 29 henries (measured at 128 cycles); the capacity of the condenser is approximately .02-mf.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2310.

TAPPED RESISTOR

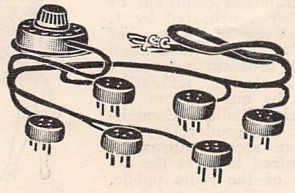
This small but sturdy center-tapped resistor is intended to be connected across the filament of A.C. tubes of the 226 type. It has a value of approximately 20 ohms, and is tapped in the exact center. Another resistor of similar construction, which is designed for use with tubes of the 222 type, has a value of 15 ohms and is tapped at 5 ohms to provide a negative bias.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2311.

A.C. ADAPTER HARNESS

The problem of how to adapt, without rewiring, a battery-operated receiver for use with A.C. tubes of the 226 and 227 types, is easily solved by the use of the A.C. adapter harness shown here. This may be used almost with any six-tube commercial receiver (except those of the superheterodyne type). Of the six adapters, four are designed for tubes of the 226 type used as radio- and audio-frequency amplifiers; one for a detector of the 227 type; and the last for a power tube of the 171 or 112 type. The adapters for the 226-type tubes are equipped across the filaments with center-tapped resistors of approximately 10 ohms. That of the power stage has a center-tapped resistor of approximately 46 ohms. The harness is formed of eight rubber-insulated leads braided together; six of these supply the heating current for the filaments at 1½ volts, 2½ and 5 volts, and the other two serve as grid returns for the direct- and indirect-heated cathodes.

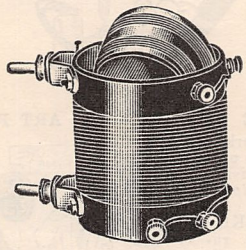


A sturdy low-resistance rheostat (approximately ½-ohm) in the filament circuit is intended to serve as a volume control.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2312.

THREE-CIRCUIT TUNER

The three-circuit tuner shown has two rotors, each 1½ inches long and 2⅛ inches in diameter; one has 24 turns of Litz wire, while the other has 16 turns tapped at the eighth. The secondary winding consists of 57 turns wound on a bakelite tube 3½ inches long and 3 inches in diameter. Its inductance is aproximately 254 microhenries (measured at 600 kc.)



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2318.

REPRODUCER UNIT

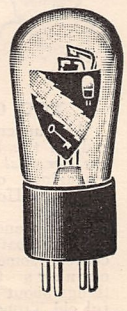
Unlike loud-speaker units of the ordinary type, which are permanently attached to the diaphragm of the air chamber or to the vibrating cone, the unit shown here is free and needs for sound reproduction neither a horn nor a cone. It can be operated in conjunction with any surface of suitable size and responsive to vibrations, such as a door, cupboard, or window pane; especially effective results are obtained when it is used in conjunction with the sounding board of a piano. This peculiar feature makes this unit a very useful attachment to any portable receiver. Its construction is of the conventional balanced-armature type, and it is enclosed in a japanned aluminum case. It operates in two different positions, either vertical or horizontal; in the former the unit simply rests on the vibrating surface. In the latter, it is suspended by its hook in such a way that it is pressed by its weight

against the responsive surface, with which it makes contact through the little ball at the end of the vibrating reed. It is of German make.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2319.

VACUUM TUBE

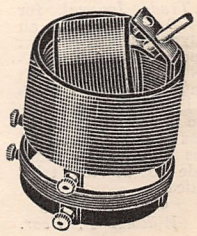
The vacuum tube illustrated is for A.C. operation, and made in both the direct- and the indirect-heated cathode types. The former is of 226 type and requires 1.05 amperes at approximately 1.5 volts for normal operation. Its dynamic characteristics (with 84 volts on the plate) are: amplification constant, 8.83; plate impedance, 8,500 ohms, and mutual conductance, 1025 mhos (measured value). This tube operates very satisfactorily as either an R.F. or an A.F. amplifier. The tube with the indirect-heated cathode is of the 227 type, and is designed especially to operate as a detector; its heater requires 1.75 amperes at approximately 2½ volts. The dynamic characteristics (at 44 volts) are: amplification constant, 9.12; plate impedance, 7,500 ohms, and mutual conductance, 1215 mhos (measured value).



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2320.

THREE-CIRCUIT TUNER

The amount of insulating material used in this three-circuit tuner is reduced to almost a minimum; all three windings are supported by thin, narrow celluloid strips. The pri-

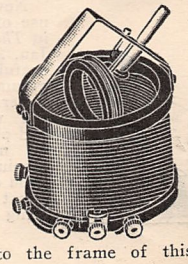


mary and secondary are each 3⅛ inches in diameter, and spaced ⅜-inch apart. The secondary is formed of 55 turns and has an inductance of approximately 232 microhenries. The tickler is 2⅛ inches in diameter and has 40 turns.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2321.

THREE-CIRCUIT TUNER

The secondary winding of the three-circuit tuner shown here is constructed on the same principle as that of the three-circuit tuner mentioned above, and is supported by four thin celluloid strips, which are attached to two celluloid rings. This winding is 3 inches in diameter and consists of 55 turns of double-insulated coupled wire; it has an inductance value of approximately 220 microhenries. The primary and the tickler are wound on two slotted celluloid rings. The primary is 2⅜ inches in diameter, and the tickler 1¾ inches. The coupling between the primary and the secondary may be varied within very wide ranges, by means of a specially-curved mounting bracket which attaches the pri-



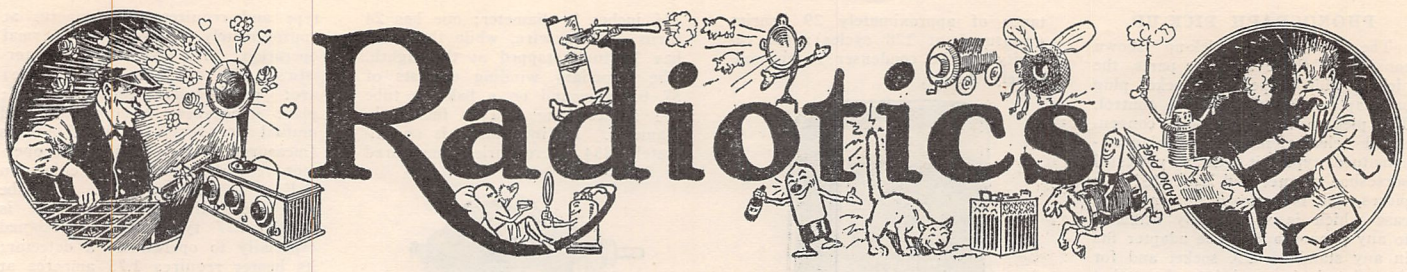
mary to the frame of this three-circuit tuner.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2322.

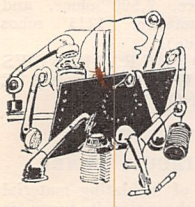
R.F. TRANSFORMER

This radio-frequency transformer is of the plug-in, low-loss type. The

(*Continued on page* 1295)



MANUFACTURERS, PLEASE NOTICE

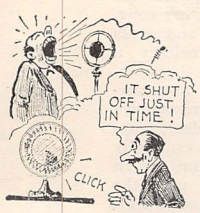


A boon to the overworked radio manufacturer is presented in the advertising columns of the *Philadelphia Daily News* of Jan. 27. "Electrical Pick-Up MAKES your phonograph and radio." Not so bad at all. We suggest that a few pick-ups be set turning out radio receivers; they could be made to sell very cheaply, we should guess.

Contributed by
Benj. J. Spotts.

VERY AUTOMATIC

In the *Western Music & Radio Trade Journal*, for Jan. 1928, is pictured an electrodynamic loud speaker "equipped with a SHUT-DOWN transformer." It may be necessary to teach these intelligent speakers when to cease playing; but doubtless the high notes of sopranos and tenors could be made to do the trick automatically.



Contributed by
William P. Bear.

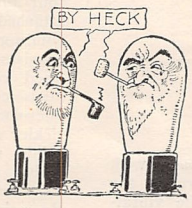
HELP! SUCCOR!! ASSISTANCE!!!

A very wet item in the *Wentworth Radio Supply Company's* catalog is a coil captioned the "DROWNING Drake." Mike of the Investigation Dept., ever ready to help in time of need, jumped in among the ether waves and rescued this bird—which we had hitherto thought one of the hardest to drown. Live and learn, say we.

Contributed by
T. C. Rumney.

DURN THEM PESKY SHOOTERS!

In the Feb. 4 issue of the *Radio World* we find, under the head of "Trouble Shooting Test Set," these remarks: ". . . and the Double R HECKER are shown herewith." But, alas and alack, we could see no picture. After great hardships and much expense we finally obtained the accompanying portraits from the hinterland. "We hope you like it."



Contributed by
H. B. Closson, Jr.

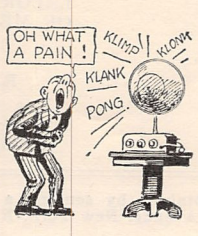
PAGE SIGNOR VOLTA HIMSELF

New discoveries in the use of voltmeters set forth in *The Kansas City Post* of Jan. 28: "One of the most useful investments to have around a set is a voltmeter. With it one can tell whether the filament and plate VOLT ACID can be neutralized with ammonium hydroxide, potassium or sodium hydroxide." What can we say to anything like this?

Contributed by
Richard E. Wiles.

TRUTH WILL OUT

In the *Broadcast Weekly* of Feb. 12 was found this very frank description of a broadcast artist, "KFWI. 10:03 to 11 P. M. Harold Reed, entertainer; Glenhall Taylor, PAINIST." In our opinion that's rather rough on the key-pounder; but he ought to be glad he wasn't described as a *cervicodynia*. (Aw, use your own dictionary—ours is cracked.)



Contributed by
Ralph L. Power.

ART FOR ART'S SAKE

Aestheticism plus demonstrated in the *Vancouver Province* of Feb. 13: "Radio Inlaid MAHOGANY TUBES SPEAKER AND STORAGE BATTERY." It seems to us that this is carrying things too far. The old-fashioned glass tubes and storage batteries (whatever they're made out of) are good enough for us.

Contributed by
Arthur W. Freeman.

HERE'S YOUR CHANCE

Another of the well-known steps forward of Science, reported by the *Omaha Bee-News* of Feb. 5: "PHONOGRAPH Transmitted in 90 Seconds From WEAF to Set 25 Miles Away." Some evening, when your radio set isn't behaving just as you want it, phone to WEAF and they will send you canned music in short order. Simple?

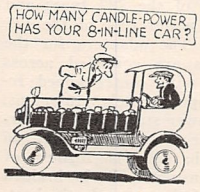
Contributed by
Lloyd Monteith.

IF you happen to see any humorous misprints in the press we shall be glad to have you clip them out and send to us. No RADIOTIC will be accepted unless the printed original giving the name of the newspaper or magazine is submitted, with date and page on which it appeared. We will pay $1.00 for each RADIOTIC accepted and printed here. A few humorous lines from each correspondent should accompany each RADIOTIC. The most humorous ones will be printed. Address all RADIOTICS to

Editor, RADIOTIC DEPARTMENT,
c/o Radio News.

USE FOR OLD BATTERIES

On an instruction sheet supplied with the Westinghouse Battery charger we find this interesting caption: "Fig. 1—Method of Connecting Rectigon for charging *automobile OF radio* "A" batteries." Not for us, not even when Henry is dispensing his wares to the public at such a cheap price. Distilled water is still cheaper than gasoline.



Contributed by
Mrs. Lawrence Davis.

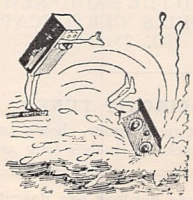
SAY IT AIN'T SO, COMMISH!

Explanation of the present scrambled condition of the ether vouchsafed by J. P. McEvoy in *Liberty* of Feb. 25: "This is Station WWW broadcasting over a BAND of 980 KILOCYCLES by authority of the Federal Radio Commission." No wonder they tell us that special apparatus is required to meet the demands of the radio public.

Contributed by
William R. Smith.

YOU GOT TO CATCH 'EM YOUNG

Announcement of Conrad, in the February *Dealers Personal Edition* of this magazine, of a diagram showing "How to Make the Tropadyne SUPERDIP," causes wonderment about this acrobatic stunt. Of course, some of these set owners tell wonderful things about what the faithful old Trope will fetch in; but we didn't think it had such versatility.



Contributed by
Phillip Morris.

TURN THE CRANK

Wild advertisement in the January issue of the *Citizens' Radio Call Book*: "Audio Transformers sold in sealed NETS, they are fully guaranteed in every way." In this cage, ladies and gents, we have the wild Audios transformum which must be caught in its native lairs, in nets which are sealed carefully so they won't escape. Larry, do yer stuff!

Contributed by
H. C. Heidrich.

EXIT LOUD SPEAKERS

Another revolution forecast in an advertisement in the *Hamilton-Carr Corp.* catalog: "Wire for use as hook-up wire, bell or ENUNCIATOR wire." Let us whisper you a secret; Use this wire to connect up the next set you build and the connections will do all the singing and playing. No use for the old cone.

Contributed by
Roy A. Jenkins.

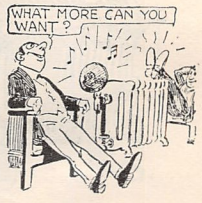
FAMOUS PARTNERSHIP DISSOLVED

Interesting advertisement in the *Detroit News* of Feb. 17, wherein is offered a "Browning & DUKE receiver." Evidently part of the radio combination decided to get out and now we have tobacco entering the field. We'll not walk a mile to ask Dad if he found a cough in a carload and is satisfied.

Contributed by
C. C. Whittaker.

R.C.A. ENTERS NEW FIELD

From the *Bangor (Maine) Daily News* of Jan. 6 we have an advertisement which extols "RCA RADIATORS." It sure looks as if the engineers of that company were afraid that perhaps a user might get cold feet or something like that. Maybe the radiators are to be used in heating apartments or certain departments.



Contributed by
E. L. Dobbins.

MATRIMONIAL OR FINANCIAL?

The *San Francisco Examiner* of Feb. 5 states: "If this does not cover the whole wavelength BOND connect a .00025 condenser in series with ANT." It might be marital because we heard the other night a wife say to her better 99%: "Tune in and get on my wavelength" during an argument. Still, Wall Street is always a busy place.

Contributed by
L. H. Hueter.

"PAPA, BUY MIKE ONE"

Mike of the Investigation Dept. made this plea when his attention was called to this item in the February *Radio World*, viz: "If a considerable RUM is present it may be due to an open 30-ohm potentiometer." We admit that the potential of some rum we have met was rather high; so we'll keep all such potentiometers for ourself. Mike's too young.

Contributed by
D. E. Mead.

Conducted by C. W. Palmer

THIS Department is conducted for the benefit of our Radio Experimenters. We shall be glad to answer here questions for the benefit of all, but we can publish only such matter as is of sufficient interest to all. Inquiries about comparative merits of apparatus cannot be answered.

1. This Department cannot answer more than three questions for each correspondent. Please make these questions brief; if the inquiry is concerning a circuit other than a standard, published one, delay will be prevented by enclosing a diagram and other necessary information.

2. Only one side of the sheet should be written upon; all matter should be typewritten or else written in ink. No attention paid to penciled matter.

3. Sketches, diagrams, etc., must be on separate sheets. This Department does not answer questions by mail free of charge.

4. Our Editors will be glad to answer any letter, at the rate of 25c. for each question. If, however, questions entail considerable research work, intricate calculations, patent research, etc., a special charge will be made. Before we answer such questions, correspondents will be informed as to the price charge.

COIL DATA

(2273). Mr. A. Wedelich, St. Louis, Mo., writes:

Q. "Please furnish me with a chart showing the simple calculation of coil windings. I have several books on radio, but most of them give rather intricate formulas that involve algebra and higher mathematics and are too deep for me.

"The coils I wish to construct are for the broadcast band; the primary, secondary and tickler for radio-frequency transformers, antenna coupling coils, etc."

A. You will find below a chart of inductance coils suitable for use over the wavelength band between 200 and 550 meters with condensers of .00025-, .00035-, .0005- or .001-mf. This chart shows the size of the secondary coil for use in the coupler. The size of the primary and the distance between the primary and secondary are matters which depend upon the particular circuit in question and the size of the coil used. As an example, a radio-frequency coupling coil, to be used with a neutralized circuit when a 3-inch tube is employed, can contain 15 or more turns of wire. In a circuit which is not neutralized, this value will have to be reduced to 12 or 10 turns. In actual practice it is a simple matter to find the value which will supply the desired characteristics.

The turns on a tickler coil for use in a regenerative circuit can be figured at about two-thirds the number of turns of wire on the secondary coil. This proportion, however, does not hold true in all cases, especially when vacuum tubes such as the 199-type are used. In this case, the size of the tickler coil will have to be increased, since this tube does not oscillate as freely as the 201A-type.

The distance between the secondary and tickler coils also affects the size of the coil; and the use of resistors or condensers for controlling the regeneration also changes this value. The actual size of the tickler coil can easily be determined when the set is in operation. If the regeneration is too strong and cannot be controlled, the tickler coil should be reduced in size; while, if sufficient regeneration is not obtained, the size of the coil should be increased.

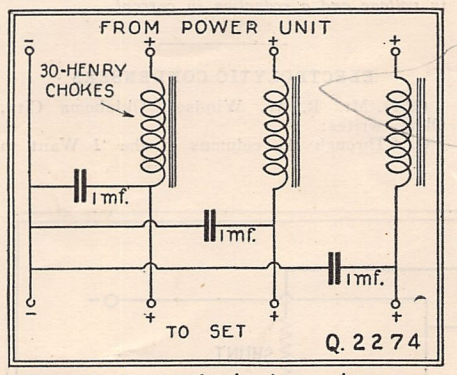
Wire D.C.C.	Diam. of coil inches	Maximum capacity (MF.) of tuning condenser .00025	.00035	.0005	.001
	2	165	125	92	53
	2½	122	92	68	40
No. 20	3	90	69	54	35
	3½	76	59	46	28
	4	66	53	40	25
	2	140	105	81	50
	2½	108	82	62	38
No. 22	3	84	66	50	32
	3½	74	56	42	27
	4	60	48	37	24
	2	132	100	77	45
	2½	97	75	59	35
No. 24	3	78	62	46	29
	3½	65	53	40	26
	4	53	42	35	23
	2	120	93	69	44
	2½	89	70	52	34
No. 26	3	72	56	45	28
	3½	61	48	37	25
	4	51	41	33	22

FILTER CIRCUIT

(2274). Mr. J. Blackman, Baltimore, Md., writes:

(Q). "I am using a double-impedance-coupled amplifier with a 'B' socket-power unit, and I am experiencing a considerable amount of 'motorboating' with this arrangement. Can you suggest some method which will help to overcome this difficulty?"

(A). There are several methods which can be used to eliminate the trouble you are having. The use of a voltage-regulator tube in the power unit will probably overcome the difficulty and, if this is not practical, a filter circuit such as that shown in Fig. Q. 2274 can be used. This filter consists of an audio-frequency choke in each of the "B+" leads, and a by-pass condenser between each of these filter coils and the "B—" terminal.



A remedy for motorboating in a resistance- or choke-coil-coupled amplifier is found in the filter diagramed above.

"Motorboating" is caused, in some cases, also by the use of incorrect "C" bias on the amplifier tubes in resistance-coupled and choke-coil-coupled amplifiers. The use of a high-resistance voltmeter to measure the output voltage of a "B" power unit is advisable; in this way, one can tell very easily what "C" bias is necessary, since the exact "B" voltage is known.

CIRCUIT TESTING

(2275). Mr. J. R. Lopez Sena, New York, N. Y., asks:

Q. "Can you furnish me with the circuit diagram and specifications for a circuit tester, which is capable of testing the various circuits in my receiver and is similar to the commercial testers on the market. This unit does not need to be as simple in operation as the commercial products, since I would not be able to employ a multi-pole switch such as they use.

"In these units a milliammeter is arranged with series and shunt resistors to measure the plate voltage, the plate current, the filament voltage, and the comparative plate-current values for different grid biases. The unit is equipped with a plug which is inserted in the tube socket of the set, so that the circuit can be tested while the set is in operation. The tube is placed in the unit and its operation is controlled with the various switches in this unit."

A. You will find the diagram of a tester of this type on the next page (see Fig. Q. 2275). An 0-to-1-scale milliammeter is used; and it will be necessary to obtain a shunt from the manufacturer of the meter so that it can be adapted to readings from 0 to 20 milliamperes. If desired, an 0-to-20-scale milliammeter may be purchased and the shunt removed and used externally.

The other apparatus required comprises a four-pole double-throw switch (B), a double-pole double-throw switch (D), a single-pole double-throw switch (E), a single-pole single-throw switch (C), and a multi-pole switch (A) used for testing the various voltages of the plate supply. The last may be of the ordinary panel-mounting type with an arm and switch points mounted in the panel.

It will be necessary to use also a tube socket, an old vacuum-tube base, and several fixed resistors to convert the milliammeter into a voltmeter. With a milliammeter with a scale reading from 0 to 1 milliamperes, it will be necessary to use an 8,000-ohm resistor for the 8-volt tap, an 80,000-ohm resistor for the 80-volt tap, and a 200,000-ohm resistor for the 200-volt tap. If an 0-to-20-scale milliammeter is employed with the shunt removed, it will be necessary to be sure that the milliammeter registers 0 to 1 milliamperes over the complete range, since it cannot be used if this is not true.

Use of the Tester

The various tests that can be accomplished with this unit are made as follows:

(1). To measure the plate voltage, turn the switch B to the voltage side and turn the switch A to the 80- or 200-volt tap; that is, to point 3 or 4. Switch C should be open and switch D should be in position 1, unless the wiring is reversed in the receiver. This can easily be determined by throwing switch A to point 2, and closing switch C. If the meter registers correctly, the switch (D) should be left in that position. If it does not register on the positive side, the switch D should be reversed. When measuring the voltages, switch E should be in position 1.

(2). To measure the plate current, switch B should be in the milliammeter position, and switch A should be at point 1. Switch C should be open, switch D in the positive position, depending upon the wiring of the set, and switch E on point 1.

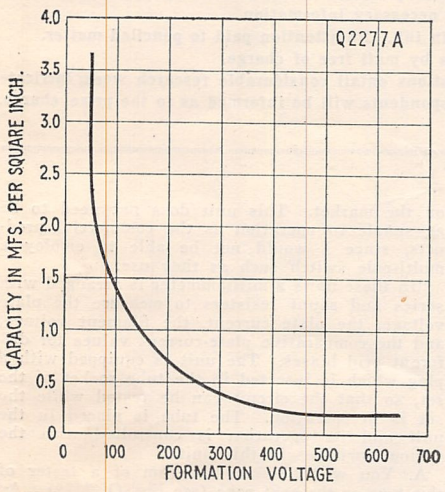
(3). To compare the grid currents of the tube with and without bias or with a positive bias, leave the switches in the milliampere position, and change switch E from point 1 to point 2. This places the grid return of the tube directly

on the "F—," and removes any bias which might be obtained through the set. By reversing switch D, it will be possible to place a positive bias, equal to one-half the value of the "A" battery, on the tube. While these grid measurements do not show any direct values, they are helpful in comparing the plate-current consumption of a vacuum tube under different grid conditions; and *comparative* values can easily be determined with tubes of known value. They will indicate whether the tube is operating correctly or not.

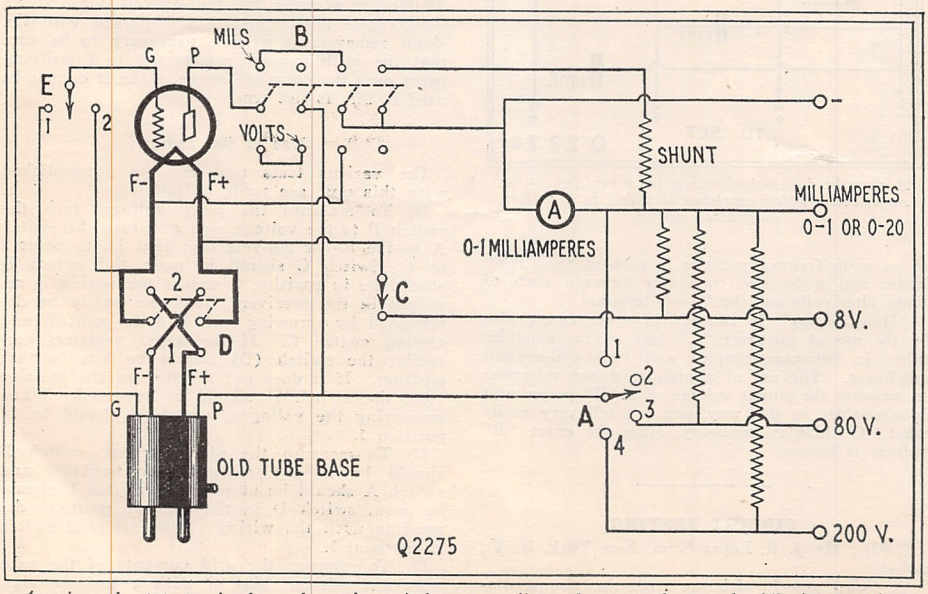
(4). To measure the filament voltage, switch B should be in the voltage position, switch A should be in position 2, switch C should be closed, and switch D in the position which supplies the positive reading.

(5). To use the meter and resistors in the unit separately, the external binding posts should be employed. For milliammeter readings, the negative binding post and the milliammeter binding posts are used. If a range of 0 to 1 milliamperes is required, the switch B should be open; and if a range of 0 to 20 milliamperes is required, the switch B should be closed on the milliampere side. To use the various voltage scales, the switch B should be opened and the correct voltage binding post in conjunction with the negative binding post should be used. When using the external section of the unit, the plug-in tube base should be removed from any socket in which it has been previously used.

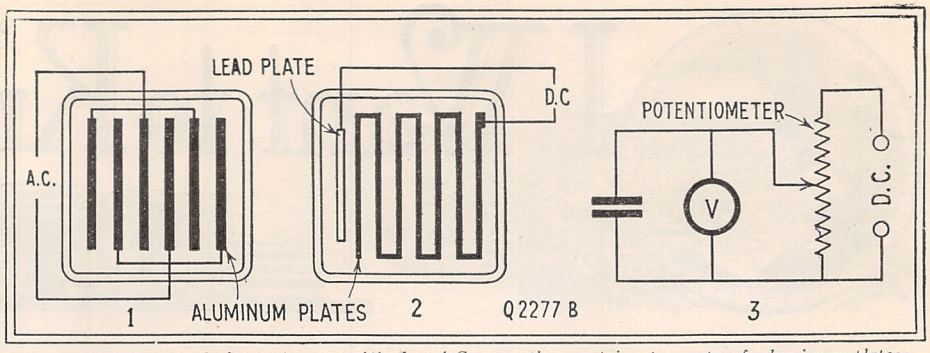
This unit is quite useful for use in testing radio sets, vacuum tubes, etc.; and, since the meter with the resistors described above produces a voltmeter which has a resistance of 1,000 ohms per volt, the unit is also valuable for use with sets employing power units, for measuring the output of "B" power units, etc. The resistors used in the voltmeter section of the unit should be as close to the value shown as possible. Fortunately, there have been recently placed on the market some resistors which are accurate within plus or minus one per cent. This is close enough so that the voltmeter readings will be sufficiently accurate for ordinary work. It will be necessary to recalibrate the meter; either by making comparative points equal to a given value for each of the resistors and plotting a graph of the readings, or by taking the glass front from the meter and inserting a new scale.



This graph indicates the approximate capacity of an electrolytic condenser, the size of whose plates and formation-voltage are known.



A universal set tester is shown here; its switch system allows the set to be tested while in operation. The plate voltage, plate current, filament voltage and comparative grid readings can be obtained with a unit of this type.



Two types of electrolytic condensers: (1) for A.C. operation contains two sets of aluminum plates; (2) for D.C. operation has one set of aluminum plates and a small lead plate for making connection to the electrolyte. Diagram 3 shows how a low-voltage condenser can be "formed."

OUTPUT DEVICES

(2276). Mr. C. W. Hall, Philadelphia, Pa. asks:

(Q.) "Is there any advantage in using an output transformer to couple the loud speaker to the receiver, other than the protection that it offers?"

(A.) If it is not possible to match the impedance of the loud speaker to the impedance of the last tube in the receiver, it is advisable to use an output transformer to compensate for the difference.

In other words, if the loud speaker has a *lower impedance than the tube,* a transformer with a high-impedance primary and a low-impedance secondary would be used. In this case the transformer would have a step-down ratio and the *voltage of the secondary would be lower than that in the primary.*

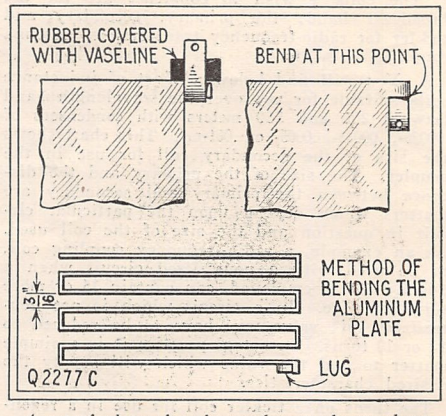
If it is necessary to use a low-resistance tube with a high-resistance speaker, the characteristics of the transformer must be reversed. That is to say, the transformer should have a *small primary and a large secondary;* thus producing an *increase in voltage and a reduction in current.*

ELECTROLYTIC CONDENSERS

(2277). Mr. R. W. Windsor, Oklahoma City, Okla., writes:

Q. "Through the columns of the 'I Want to Know' Department, will you please give us details on how to make an electrolytic condenser suitable for heavy-duty "B" power units."

A. The theory of the electrolytic condenser is as follows: When an electrolytic cell consisting of an aluminum and a lead plate and a suitable electrolyte is connected to a direct-current line, with the aluminum plate as the positive terminal, a uniform film, without pinholes, is formed over the entire surface of the aluminum plate. This film is a very good insulator and reduces the direct current almost to zero. In this case, there is no leakage current caused by sparking, as happens when the cell is used for rectifying purposes. The small leakage current at the point where the aluminum electrode leaves the solution can be reduced to an almost negligible amount by carefully insulating the aluminum plate where it enters the liquid. A cell of this type forms a very good high-capacity condenser, with the gaseous film acting as the dielectric.



A set of plates for the condenser shown above at (2) may be made from one aluminum strip as shown.

This condenser is limited to a certain voltage at which the film breaks down, allowing current to flow again until a new film is formed. Because of this fact, the electrolytic condenser is not injured by breakdown, since it takes only a short time to form a new film. Various electrolytes have different critical voltages, and for high-voltage work some are more suitable than others. The critical voltages of some of the common electrolytes are as follows:

Sodium sulphate, 40; potassium permanganate, 112; ammonium chromate, 122; potassium cyanide, 295; ammonium bicarbonate, 425; sodium silicate, 445; ammonium phosphate, 460; ammonium citrate, 470; sodium biborate ("borax"), 480.

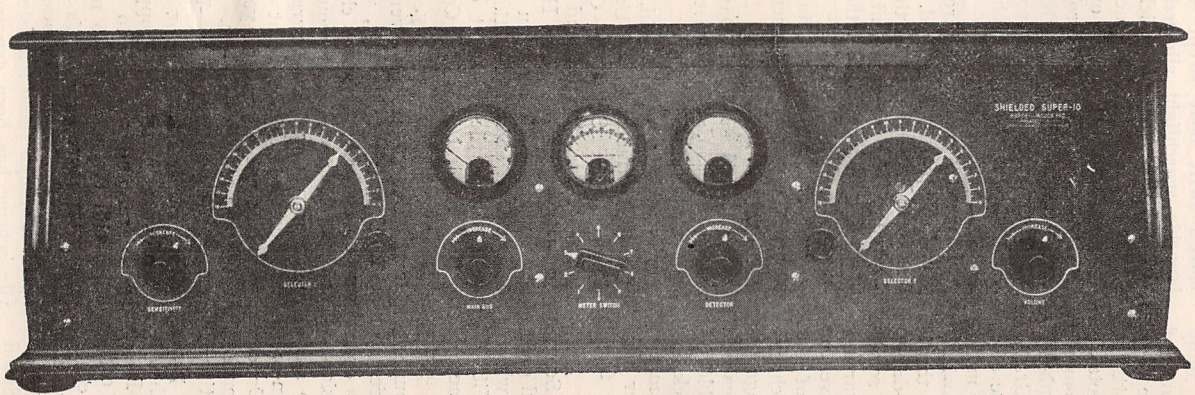
The critical voltage is approximately correct when aluminum plates and the electrolyte formed by a 1% solution of one of the respective chemicals shown above are used. The approximate capacity obtained per square inch of condenser plates depends upon the formation voltage. The graph (Q. 2277A) shows these approximate values.

The construction of a condenser which may be used for "B" power units can be accomplished as follows:

A piece of extra pure or No. 1 aluminum, about six inches wide, should be cut from 1/16-inch or ⅛-inch material. The length of this aluminum sheet depends upon the capacity of the condenser and the size of the container. It should be bent back and forth as shown in Fig. 2277C. A lug should be left on the end of the plate, so that a contact can be easily made to

(*Continued on page* 1295)

FIVE TYPE UX222 SCREEN GRID TUBES ARE USED IN THIS ULTRA-POWERFUL BROADCAST RECEIVER, INCREASING the RADIO FREQUENCY AMPLIFICATION and SENSITIVITY OVER 500 TIMES



Front Panel View
NEW ADMIRALTY MODEL
with complete set of indicating meters. Panel size 9 x 36 x ¼ inches. Weight 45 lbs.

Licensed under Hogan Patent No. 1,014,002

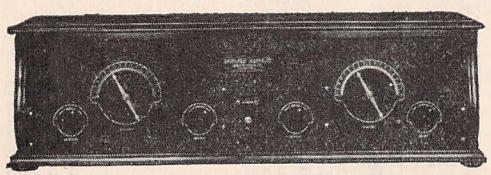
The New Norden-Hauck SHIELDED SUPER-10

Highest Class Receiver in the World

The New **NORDEN-HAUCK SHIELDED SUPER-10** is fundamentally different, being specially designed for crowded broadcast conditions. It is a long distance concert Receiver which marks radio's final arrival at the goal of the connoisseur of performance.

Far away stations are received like locals, using only a small loop or short piece of wire for the antenna. Distance possibilities seem unlimited with this new model. Usual background noises are conspicuously absent, and an extraordinary quality of reproduction is obtained with the improved audio amplifier in the Shielded Super-10.

Smashing power with complete fidelity makes previous standards of reception pale into insignificance. There is simply nothing like it. This great 10-tube Model is so far in advance of others that its absolute superiority is instantly apparent to anyone.



Standard Shielded Super-10—Front Panel view. This model is identical with the Admiralty model except for the indicating meters. However, it is equipped for the Weston Pin-jack Voltmeter.

Some Exclusive Features

1. **Ten tubes. A combination of Screen Grid and Power Tubes arranged for maximum efficiency.**
2. **Totally shielded in accordance with latest research data. Various circuits are completely isolated.**
3. **Selectivity remarkable—Tunes completely through local broadcasters.**
4. **Either A. C. electric operation or batteries may be used as desired.**
5. **Simple to operate—only two main tuning controls.**
6. **An entirely new audio amplifier, with two power tubes handling the output.**
7. **Provision made for electric phonograph pickup.**
8. **A precision laboratory instrument. Material and workmanship conform to U. S. Navy Standards.**
9. **Moderately priced. Deferred terms of payment can be arranged if desired.**
10. **Beautiful new, and less expensive console cabinets are available.**

This design and development of the Shielded Super-10 is a crowning achievement which has been made possible by the revolutionary "screen grid" tubes. It will be several years before any AC tube is developed that will even approach the efficiency of the "screen grid" tube as a radio frequency amplifier. This new tube raises the amplification factor thirty to forty times over that secured with the conventional 201-A tube.

Everyone can have this wonderful Receiving Set, for it is sold as a complete manufactured laboratory tested Receiver and also in a kit of parts for home construction, or for the professional set builder and dealer.

The full size genuine blue prints and instructions are so complete in every detail, that is is exceedingly easy for anyone to build the Shielded Super-10. Almost everything is done for you to simplify this work.

Learn more about this remarkable Receiver. Send for attractively illustrated literature on the new **NORDEN-HAUCK SHIELDED SUPER-10**, which will be gladly sent to you without cost or obligation on your part.

Fill out and mail this coupon.

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Marine Bldg., Phila., Pa.
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☐ I enclose $2.00 for which kindly send me immediately, Postpaid, complete constructional Blue Prints and operating instructions for the new Norden-Hauck Shielded Super-10.

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Engineer ☐ Professional Set Builder ☐
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.....

In The Bright Darkness

(*Continued from page* 1215)

paratus, relayed from your yacht, and broadcast from your station, WROT, to the millions of radio fans, who will witness, from their own homes, what the keenest human eye could not see from this deck!"

"You have done well, Scott," approved Harold Dare. "We have only to await the arrival of the conspirators."

They seated themselves and donned the headsets of the sound reflector. Many sounds came to their ears—the sound of water sloshing against the stern of the other yacht; the hum of generators, the rattle of a chain, the clanking of metal on metal, a confused murmur of voices. Moments passed. Then in the sensitive headphones faintly sounded the hum of a motor. Gradually it grew to the full, smooth drone of a powerful engine, muffled, but working under a heavy load. Scott turned to the switchboard beside him. One by one he threw the heavy copper blades. The motor-driven cameras whirred; with a cracking sound the huge infra-red ray generators warmed to their work, sending out great waves of heat. In the head-sets the sound of the motor suddenly died. There was a churning of water and a scraping of wood against wood. Chains clanked; pulleys squeaked; there was a scuffle of feet, a rumble of heavy objects being drawn over decks, a murmur of voices. Then the idling motor rose to a roar, and a purling of water told that the launch was speeding away from the yacht.

"They have loaded the guns!" cried Scott. "Let us act!" Harold Dare scrambled over the ship's side into the speed boat, whose motor was now gently purring. With a roar the powerful launch cut swiftly across the harbor toward the yacht.

In the studio at WROT, the announcer spoke: "Friends of the air! we present tonight the most spectacular scene ever brought to the world through television—an event so dramatic, so gripping, so stirring that it might well be a scene from one of Mr. Dare's great super-specials. Dandy Diavolo, with reckless disregard of public welfare, of law, of ethics, of international relations, has planned a perfidious plot. But through the unflagging zeal and almost superhuman cleverness of Harold Dare alone it is being foiled as neatly and completely as the most critical film fan could desire. Friends, with the eye of television, you are about to penetrate the darkness of midnight, as no human eye could do. Stand by for television!"

In millions of homes, people threw the switches of their television receivers, and on millions of silver screens flashed out a long, low, rakish yacht, silhouetted against an inky-black sky. Closer and more sharply defined it grew as Scott focused the telephoto lens of the television equipment. On the deck, a man wearing headphones, sat at a large kettle-drum-shaped device, while a number of desperate appearing men lowered the last of the packing-boxes below deck. Suddenly the man at the sound detector stood up, and millions of gasping film fans recognized black Dandy Diavolo, hated villain of the Flicker Films. He turned the crank of the sound detector, listening intently. Then he waved his arms and the listeners heard: "Overboard with everything—we are discovered!" His henchmen sprang into feverish activity. Winches clattered, as frantically case after case of guns was hauled forth and plunged overboard. As the last case disappeared beneath the waves, a streak of white flashed upon the television screen, and with a roar Harold Dare's swift boat swept alongside. The launch's searchlight climbed upward. As if before the Kliegs of Flicker Films, desperate Dandy Diavolo faced the bright beam of light and walked over to the rail.

"Avast, there! cried Harold Dare, in his best nautical manner. "Belay you! Lay to! Heave up, Dandy Diavolo!"

"What means this foolery?" snapped Diavolo.

"It means," retorted Harold Dare, "that your little plot is discovered. We command you to halt, to lay to, in the name of the United States Government, the Federal Coast Guard Service, and the Harold Dare Studios!"

Diavolo's face twisted into a fantastic sneer. "Very well, gentlemen. If you wish, come aboard."

He dropped a ladder. Dare and his men climbed aboard. The Coast Guard officer stepped forward.

"Dandy Diavolo," he said, "in the name of the Government of the United States of America, the State of California, the County of Los Angeles, and the City Governments of Los Angeles, Hollywood, and Beverly Hills, I arrest you for attempted gun-running, and for violation of the Monroe Doctrine, the Covenant of the League of Nations, and the Penal Code!"

Diavolo laughed harshly. "This time, Harold Dare, you have overreached yourself. You, my fine fellow, will suffer for causing an arrest on false charges. Think you that Dandy Diavolo would not foresee and forestall such an emergency as this? You may search the yacht from stem to stern, but not a gun will you find. Then it will be my turn to laugh. You shall rue this day—or, rather, night—Harold Dare."

Dare laughed in his turn. "Ah! Dandy Diavolo, so you have dropped the guns overboard, and propose to salvage them later with divers. You do not know that your every move in tonight's affair was betrayed by the bright darkness of infra-red light. Through radio television, your whole vile scheme has been exposed to the eyes of the world. You thought to keep your evil deeds dark; but the searchlight of justice inevitably finds out the transgressor—especially when it is an infra-red searchlight. The whole sequence of this scene is imperishably recorded on motion-picture film. A fine picture it will make—one that will entertain the stern judges in Federal Court, when the whole scene is re-enacted before their eyes, and when they inspect the cases you hurled overboard, all neatly numbered, 'exhibit A, B, C, D, E, F, G,' etc., to the end of the alphabet. It will be a picture which critics will acclaim the most realistic and thrilling of your whole career as a master-villain. How the sober judges will grip their chairs and hiss you when they see you

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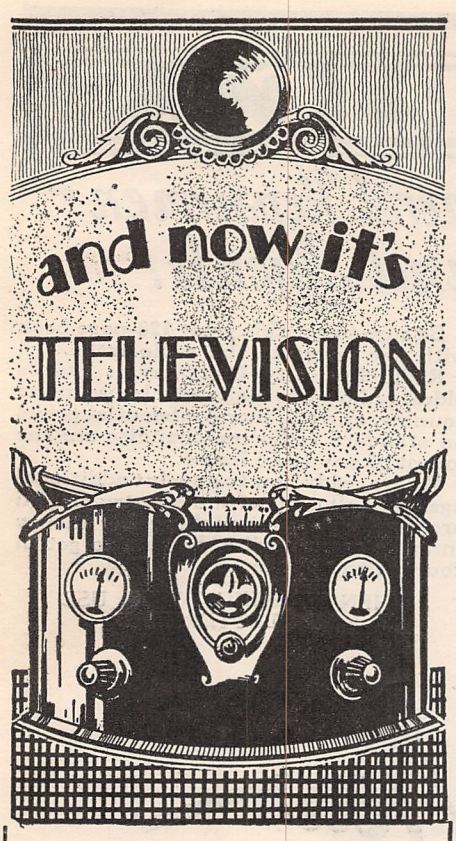

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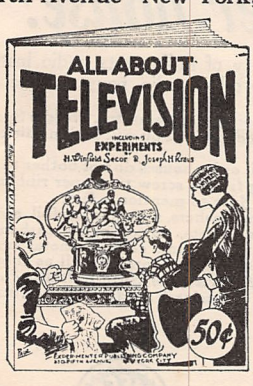

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and your minions loading the contraband cases aboard your yacht; and how they will applaud this final scene, in which you are neatly foiled!"

Diavolo gasped. He turned wildly, but saw only menacing faces. Dare turned to the government official. "Officer, do your duty." Drawing from his pocket a set of strong steel handcuffs, the officer snapped them upon Diavolo's wrists. "At last, Diovolo, you are caught in the toils of justice. Now we must search the yacht."

Dare took the lead. They found nothing of suspicious importance until they came to the last cabin. The door was locked, but dauntless Harold Dare was not to be deterred. "Break down the door, men," he commanded. Diavolo paled. Before the onslaught of two brawny sailors the panels splintered, the lock broke, and the men were sent flying into the room. Harold Dare stood transfixed with amazement. There was a ripple of feminine laughter—he looked into a face he knew full well.

"Rose!" he gasped.

"Harold, my hero!" cried the girl.

And, as if before the clicking cameras, Harold Dare and Rose Blush fell into a splendid, soul-satisfying clinch. And again the arch-villain, in his soul-searing despair, realized that fate holds few favors for him who flouts the forces of justice, and that to the brave alone belongs the fair.

How Broadcast Programs Reach Broadcast Stations

(*Continued from page* 1213)

up-grades to maintain the minimum speed, and the brakes used when going down hill, to keep the car from going faster than 60 miles per hour.

The up-hill part of the analogy is the pianissimo minimum of a scale reading of 30 and the down-hill part is the fortissimo maximum of 60. It can be understood that, just as there are hills of different grades, necessitating either more braking or acceleration, so also there are different volumes of music-making power necessary, more or less, as the case may be, to maintain and observe the limits of 30 to 60 on the volume indicator.

This constant adjustment of the volume indicator necessitates a familiarity with the musical selections on the part of the operator at the pick-up point. He must know when there is to be a crescendo, so that he can reduce the volume at the proper time; when an incidental violin solo is in the selection he must be aware of the fact, and bring up the power so that the music will register in the loud speakers.

AT THE CENTRAL STATION

As mentioned previously, the night club is connected by telephone lines to the central broadcasting building. Before these lines are led to the switchboard, which distributes the music to the transmitter, they go to another amplifying system, similar to the one at the night club. In addition to this is an instrument called a "pad", which also plays an important role in keeping the quality up to a high standard. This pad has the function of *reducing* the volume of the "line noises" just after the program comes from the telephone line.

It seems safe to assume that every reader of Radio News has at some time or other used a telephone and, therefore, knows that there is always a certain amount of line noise superimposed on the conversation. This happens in the land lines connecting the night club to the main building, but not to as great an extent as in most telephone circuits; for these special lines are very carefully balanced to take out as much of this noise as possible.

Now the amplifier at the night club amplifies only the music; but, by the time the signal reaches the central building, it has superimposed on it some of the land-line noises. If this combination were amplified again and put on the air the audience would hear in their loud speakers an extra amount of noise and conclude that "the static is awful tonight." The pad mentioned above has the ability to filter out the line noises; so that when the signal is again amplified the line noises are practically eliminated and only the music is amplified.

AT THE TRANSMITTER

At the central building there is also a volume-indicating meter, which is synchronized with the one at the night club. This is constantly observed by an operator; but the control is left entirely to the man at the pick-up point. After being again amplified, the signal comes to the switchboard, where it is routed to Bellmore, Long Island, the location of WEAF's transmitter (and also to the different stations in the network chain) by means of plugs and jacks, such as are used in an ordinary telephone exchange.

When the land lines have finally carried the signals to the transmitting station, they are again amplified before they modulate the carrier-wave of the station; *i.e.*, before they are combined with the high-frequency current that is generated at the transmitter. It is the frequency of this carrier wave that determines the wavelength of a station. The modulated carrier current is then amplified many times and is finally led to the transmitting antenna, from which the wave leaps off into space.

Exactly what occurs between the time the wave leaves the antenna at the transmitter and the time it energizes the antenna at the receiving end is too technical to go into in this article (and, confidentially, not too well understood, even by experts). Let it suffice to say that series of electromagnetic waves are set up in the ether and these act on the receiving antenna system; so that electrical currents are set flowing in the radio-frequency amplifier of the listener's set, are detected and then amplified further at audio frequencies. These audio currents are finally turned into sound energy by the loud speaker.

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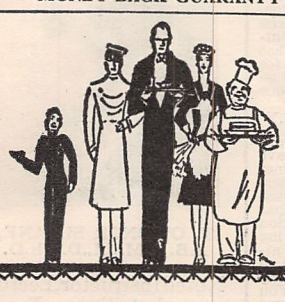

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made at pick-up points, such as Roxy's Theatre, The Capitol, etc., from which programs are regularly broadcast. For example, in the former theatre, as many as twelve microphones, scattered about the stage, footlights and in the orchestra pit, are sometimes used. These microphones are connected to a microphone mixing panel, where the output of each pick-up can be regulated. This is necessary for several reasons. In the first place, let us suppose that the full orchestra is accompanying a singer, and that it is desired to broadcast the combination. In the majority of cases the musical accompaniment almost drowns out the singer's voice; but when this is broadcast the output of the microphones in the orchestra pit is toned down so that the accompanying music takes its rightful place, in the background of the singer's voice. Thus, we actually hear better results over the radio than if we were sitting in the theatre.

This theatre has also a studio from which various programs are broadcast, and it is a simple matter to switch on the microphone in the studio instead of those on and about the stage. Instruments similar to those previously described for picking up a program from some remote point are permanently installed. They are the same, with the exception of the microphone mixing panel, which is more complicated, as there are more microphones to adjust.

When a program is put on the air from one of the station's studios in the central building, the steps taken are almost identical, the only exception being that one less amplifier and operator are required. The operator controlling the volume output from the studio is situated in a room adjoining the studio, and he can observe everything that occurs therein. The output from this amplifier goes to the switchboard room where it is routed to the transmitter at Bellmore, L. I., and any other stations that are putting on the same program.

Coming—A Program Pool?

(*Continued from page* 1203)

CAN THEY GET TOGETHER?

Ignoring its commercial implications, and taking into account only the fact that the Radio Corporation is the chief owner of the National Broadcasting Co., this arrangement can be properly, if narrowly, viewed as a substantial step toward the ultimate creation of a plan under which all manufacturers would contribute to a common pool for the financing of broadcasting; and hence of one by means of which the listener would pay for programs indirectly through the purchase of receiving equipment.

As to the practical factors involved in putting such a scheme into operation, the first necessity is, obviously, that it include *all* those interests which profit directly from broadcasting; not only the manufacturers of receivers and such accessories as tubes, loud speakers, parts, power devices, batteries and cabinets, but also the electrical utilities (since it is well known that they enjoy augmented revenues from the growing use of power-operated receivers) together with the telephone interests, whose lines are employed in chain hookups. At first glance this would seem to present insurmountable obstacles, but closer inspection reveals that such should not be the case.

There are already national trade associations representing most of the groups affected. The Radio Manufacturers Association, the radio division of The National Electrical Manufacturers Association, and The National Electric Light Association, to mention only a few. Representing the stations, there is also the National Association of Broadcasters. So the setting up of suitable machinery, which would serve as a common medium for all, would seem to depend only on the desire of these various groups to cooperate, one which has already been demonstrated in convincing fashion. (Once the plan were well launched, too, practical pressure would virtually force in any "slackers.")

The matter of payment offers somewhat more involved difficulties. In the case of manufacturers, this could, of course, be prorated on the basis of sales; while for such interests as the utilities it might better be estimated. Allowance, too, should be granted those radio interests which maintain stations. But the spirit of cooperation again could well be relied on to iron out the details.

OPERATING METHODS

As to operation, whether the pool should take over stations or merely supply the bulk of programs, after the manner of the chains, presents a nice question for discussion. It would seem desirable that stations, particularly of the better sort, should be permitted some latitude for individual efforts; also that the pool's facilities be made available to non-radio organizations for programs whose quantity and character are compatible with the best interests of broadcasting. There are, too, a number of broadcasters who would, no doubt, prefer to operate independently of the pool. Once more, however, these details offer no difficulties which could not be solved.

Now as to what such a pool offers:

First: it would cause the listener to pay for programs; the very obviousness of that should not obscure its desirability. There is no doubt that leaders of the industry and fair-minded fans have agreed from the beginning that this is precisely as it should be.

Our European cousins have taken the straight line toward payment by the listener, through the licensing system previously referred to, but such an arrangement can never be put into successful operation in the United States, because of the traditional resentment at anything suggesting direct taxation. Accordingly, the fact that a pool would permit the listener to pay, and *indirectly*, should constitute the most telling argument in its favor.

WHO IS SHIRKING?

Second: the proportional cost would probably be no greater than, if as large as that of the present system. For example, on the basis of $500,000,000 gross sales (the volume approximated by the industry during

1927) an amount as small as 2% would yield $10,000,000, which should go far toward paying for national broadcasting of a high order. As compared with this, it is known that some commercial broadcasters spend as much as 4% for their programs, and in addition—a third point—*many of those who benefit directly from broadcasting now pay nothing toward its cost.*

A moment's survey of the present situation within the industry will disclose that some of the largest, and a multitude of the smaller manufacturers, supply no broadcasting, yet reap nearly as much benefit from that furnished by others as do those paying the bills. This is obviously unfair, but, as things stand, cannot be corrected. With a comprehensive program pool in operation, however, (and, as suggested, practical pressure should make it comprehensive), each manufacturer would pay toward the total cost in proportion to the benefit derived.

Fourth: a pool of the type outlined would have the highly-desirable effect of placing broadcasting under the practical control of radio interests. Not the least grotesque phase of the present situation is the fact that a large majority of the stations are owned by non-radio interests. It is true that many of these are among the best stations on the air. But it is also true that those which are generally conceded to be contributing least, if anything, to broadcasting are, with few exceptions, owned by non-radio interests. And, as pointed out previously, broadcasting is at best of only incidental value to non-radio interests; while to the radio industry it is the thing which makes existence itself possible.

Accordingly, it is most advantageous—if not imperative—that the radio industry have as nearly complete control as possible over broadcasting; and, with a pool acting as a medium for the provision and supervision of programs, this end could be attained in a practical way, even without disturbing the ownership of stations.

Fifth: a pool would permit broadcasting to be carried on in the interests of the entire industry, and with a national perspective.

LACK OF SYSTEM

Laudable and noteworthy as have been the contributions of many manufacturers in the way of broadcast programs, it is nevertheless clear that their efforts have been inspired more by self-interest than by desire to advance the interests of the industry as a whole. This is a state of mind human enough, but one which has not made

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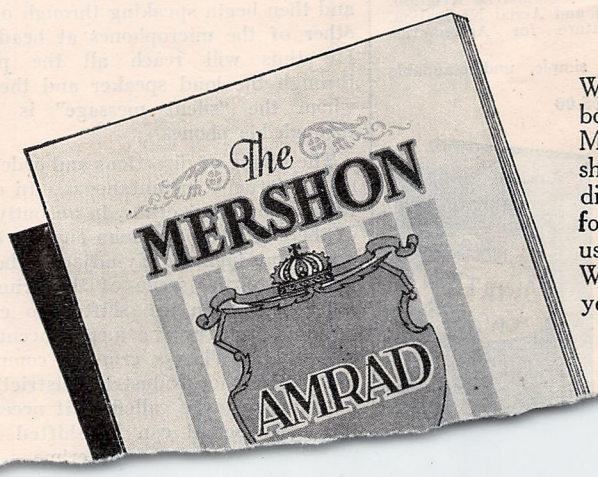

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for maximum progress, because of the obvious losses introduced by competition and duplication of effort.

Similarly, the industry has suffered on account of the lack of not only a definite national broadcasting policy, but a single agency charged with the responsibility of providing broadcasting on a national scale. One result of this has been the existence of more than twice the number of stations compatible with efficient service; another, the surfeit of broadcasting in some sections and its woeful dearth in others; a third, the general unevenness of program quality and quantity the country over.

Conceivably, the Federal Radio Commission may remedy some of these serious shortcomings, but by no means all. Had a properly-organized pool been created in 1924 or '25, there would have been no need for such a governmental agency, no such formidable situation as now confronts broadcasting; and were a pool formed even today, there is ample reason to believe that it could do more to solve the existing tangle than any official body, since the problem is essentially one for broadcasting itself to work out.

This then is, in brief, the case for a program pool. The case against it is, as has been suggested, essentially the desire for individual rather than group action. How long this will continue strong enough to maintain the present illogical and confused conditions, remains to be seen. But certainly there is sufficient justification for anticipating that too long a time may not elapse before broadcasting will adopt some such comprehensive and logical plan for financing and directing itself. Portentous signs are already in the radio sky.

Radio Polices A Western City

(*Continued from page* 1223)

matically. Similarly, the operator may turn to the Morse key, which is also on his desk, and flash the lamp signal; though this flashes all red lamps on all cars. By the selective method, with the button keyboard, however, he may attract the attention of any one or a number of patrolmen.

Having flashed this call signal, the operator may instruct the patrolman by other flashes on the red lamps, or he may wait one-half minute for adjustment of phones, and then begin speaking through one or the other of the microphones at headquarters. He thus will reach all the patrolmen through the loud speaker and the one for whom the "silent message" is intended, through his phones.

The giving of directions and orders is thus made virtually instantaneous. In case of a robbery or other crime, in an outlying part of the city, the patrolman on that beat, and others on immediately-adjacent beats, can be sent to the scene of the crime; while other patrolmen are shifted to cover the beats vacated by the men concentrated at one point. When a crime is committed in the business or industrial district, all the patrolmen can be called in if necessary, or the crime squad can be shifted from its [illegible] of the crime [illegible] sys- [illegible]

central stations, and signals would be flashed over them with great rapidity; but still considerable delay was experienced, because of their ineffectiveness at times when patrolmen were driving away from the light, when they were watching houses or persons out of sight of the light, and in similar exigencies. Much time was wasted while the patrolman was driving to the nearest telephone box, even if he saw the light promptly; and during getting into and out of the car, and so on. Now the officer in charge can communicate instantly with the patrolman, start him on his way, and continue to give him instructions while he is speeding to the point at which his services are required.

So efficient has this radio control proved that Chief Vollmer has ordered a large high-speed car, capable of carrying five men, rifles and a machine gun, and equipped with both receiving and sending sets. This car will be on constant patrol, especially at night, and will be at all times in immediate and continued communication with police headquarters. It will be able to report back to the central station from scenes of crime, and thus quickly give details of the escape of criminals and the direction of their flight, their descriptions, and similar necessary information. It will be delivered sometime in 1928, and will have power enough to maintain a speed of 75 miles an hour.

ALSO A STATIC ELIMINATOR

Recently an ad appeared in the local paper as follows: "Send us one dollar and we will tell you how to reduce your radio upkeep 100%."

Having dutifully forwarded our dollar, we received the following: *"Don't use your set."—H. N. Webster.*

A TELEVISUAL TRAGEDY

*A listener living at *Belvoir*
For an artiste caught love-smitten felvoir;
But her image he spied,
Seized a hammer and cried
"Base vocal decelvoir!" and smashed his recelvoir!

—Arthur Wolfendale (England)

* Pronounced Beaver.

Listener Psychology and Radio Reception

(*Continued from page* 1217)

which is actually quite normal will appear deficient.

This is particularly true, of course, in the case of "DX" (great distance). Here, because the signals are faint at best, acuteness of hearing is as important as the performance of the receiver itself. In fact, one individual may get good DX from a receiver while another does not, merely because the former's hearing is keener or, in psychological terms, his "attention factor" is higher. So, if your set seems below par, be sure you are at par yourself before starting to look for trouble or condemning the receiver. Often you will be surprised to find the shortcomings in your mental state.

Conversely too, volume which normally seems pleasant will often appear excessive, because you happen to be nervous or mentally irritated.

"BUTTER FINGERS"

The mental factor also has much to do with sharpness of tuning. As suggested before, any tension or other disturbing state of mind which tends to diminish the necessary delicacy of touch may easily make it impossible for you to separate stations which lie close together on the dials. This is particularly true in the case of transmitters whose signals overlap, as many do in congested broadcasting centers. Here, if you are alert, you will be able to tune out the undesired background station merely by a mental effort. But if your reactions are sluggish, you will probably find it impossible to do so and bring in the station you want.

However, it is in the much-discussed matter of tone quality that psychology really takes the center of the stage in radio.

It is true, of course, that there is a wide difference among various receivers as regards fidelity of reproduction. It is true, too, that the excellence or deficiencies of tone quality can now be measured by scientific instruments to an astonishingly accurate degree. But in the last analysis, for all practical purposes, it is the reaction of the listener which determines whether tone quality is good or bad.

If he has been accustomed to rasping and blare, rasping and blare will seem quite normal and acceptable; and, even though he is accustomed to the finest and most faithful reproduction, there will be times when his mood makes this gratingly unpleasant. It is the same with painting and literature. To the untrained, Sargent and Conrad may appear boresome, and even to the highly-trained there are times when these masters are distasteful. It is essentially a matter of emotional state.

ARE YOU IN TUNE?

Accordingly, with all due respect to the fine work which has been done toward improving tone quality, don't forget to check your emotional condition against any impression you have of a given receiver's performance. If you are pleased, it may be that you are in such a contented frame of

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—Rev. H. Schaller.

Worcester, Mass.
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Childress Texas
Have had good results with your Eliminator, in fact better than they have had from an———all electric I recently heard in town.
—V. C. Kessinger.

Columbus, Ohio
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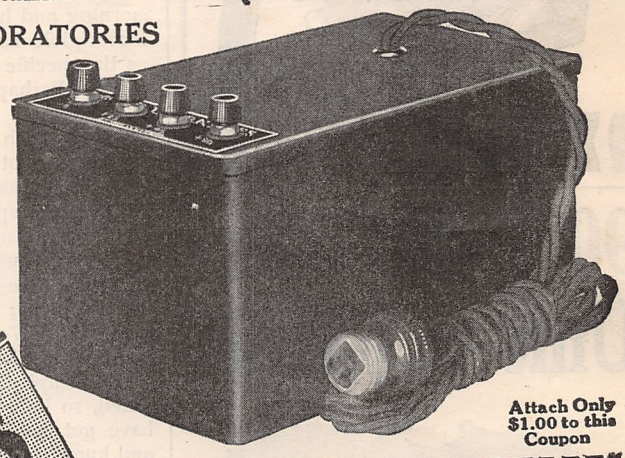

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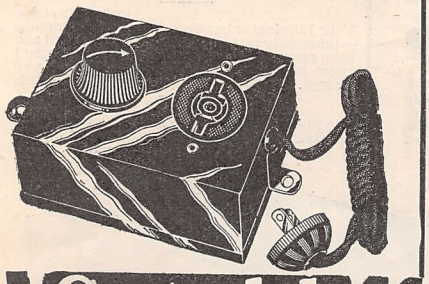

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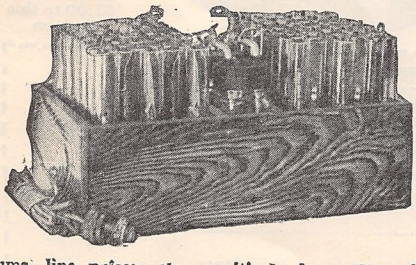

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mind that you would be pleased by anything; and if you are irritated, it may also be that you are in a mood which would find maddening the best symphony orchestra, heard in person. Our emotions exercise over our reactions an influence more powerful than any of us realize.

In fact, you will find it a considerable advantage to keep this whole matter of psychology in mind when you are confronted by some baffling quirk of reception. It will not explain such things as burnt-out tubes or blown-down aerials (unless you thoughtlessly let 135 volts of "B" battery get across the filaments, or neglect to anchor your insulators properly). But, since we are all human and the human factor is always so important, it will be found to explain surprisingly many of the shortcomings you have been laying at the door of your innocent receiver or the equally innocent weather man.

A Britisher Chats on Radio

(*Continued from page* 1221)

nese Empire and/or Republic and/or Commune; and that television does not come into general use and act as an arresting agency, *contra* the development of our ears.

A NATIONAL MONUMENT

Broadcasting in this kingdom is solely in the hands of the British Broadcasting Corporation, a very British institution indeed, as I shall show later. It is as watertight as a flatiron in the Mohave Desert; as solemn as the face of a man who has burnt out all his tubes at 1:00 a. m. Sunday morning and has no spares; as correct and incorrigible as a nun; and as unalterable as the specific gravity of H_2O at 60° Centigrade. Perhaps!

This B.B.C. now operates under a Royal Charter which renders it as inviolable as the grass-plots surrounding Westminster Abbey. Almost sacred! Certainly not to be trodden upon with impunity. Let not the nimble American mind cherish the notion that I write sarcastically of this institution. We believe in peace, except when we make war; and in stability and no fancy gun-work. We believe in the British policeman; if our hope in him is dashed we are a lost empire. We believe in being governed, so long as we believe our governors have got hold of the handle of the stick and know the rules of the games. So, when we let the government give the B.B.C. a Royal Charter, we mean that we want the broadcasting business to be conducted soberly, legally, decently, solemnly, slowly and surely. And, by the Lord Harry! it is so done—and right well do we know it.

More dates; The governors of the B.B.C. are as follow:

The Earl of Clarendon. (An Earl! I should smile!);

Lord Gainford, postmaster-general in 1916;

Sir J. G. Nairne, comptroller of the Bank of England;

Dr. M. J. Rendall, headmaster of Winchester College;

And Mrs. Ethel Snowden. Boys, this lady is the wife of Mr. Philip Snowden, who was chief of the Treasury during the first Labor administration of this country.

So you see clearly that this galaxy of talent is bound to give England—and those Scots, Welshmen and Northern Irishmen—just all the broadcast joy they want. They are a body well calculated to gauge the public taste in music and other forms of audio-enjoyment. Well, we try to keep ourselves jolly in spite of 'em.

THE COST OF BROADCASTS

The cost of a license for a radio receiver in this country is about two dollars and a half per annum. Hence the revenue from radio licenses is now about $5,889,000. The license fees are collected by our noble post office, which seizes for the cost of collection 12½%, or about $736,125. Of the remainder, some $5,152,875, the B.B.C. is allowed to retain 90% of the first five million dollars, and 80% of the second five million dollars, that is, about $4,623,300; which is quite a healthy sum, either in dollars or in pounds sterling (£924,460.)

It is not known to the public just what our B.B.C. does with over four and a half million dollars per annum; though the majority of critics agree that four millions are spent on salaries, Harry Lauder, earls, and postage stamps, and the remainder on providing programmes and radio-sleuth vans for detecting—er—is "bloopers" the word, Mr. Editor? Really! a heart-rending word. Why not call them "Yoickers"? (*From "Yoicks! Tally Ho!" a fox-hunting war-cry.*) This slang-swapping reminds me of the newly-genteel-rich but unrefined lady who visited an Art Gallery with her daughter, aged fourteen. Said the girl (pointing to a picture), "Lumme! I don't think much of that d—— thing." Said her ma: *"Ireen,* how often have I told you it's rude to point?"

WHAT SAID CHESTERFIELD?

The funniest joke the B.B.C. ever put over is its coat of arms. You would not expect a broadcasting enterprise to struggle along without a coat of arms, surely! What? Get the hook-ups, the ads., and the artists, and let fly? No, my restless, nervous, go-getter, you cannot hustle a British corporation like that. First the board of governors passed a resolution to set up a coat of arms; referred back by board of consultants on some point of heraldry. Confirmed by earl, lady and t'others. Committee then set up to consider design. Einstein, Epstein, and the art editor of *Punch* are called in as advisers. The dollars are flying, but no matter; the question of a C. of A. is vital. Experts evolve one design looking like a roulette board, and another so zoological that we are reminded of what we see on lifting up a big stone in the damp part of a garden. Then the whole thing is handed over to a public competition. Selection made; executed in gold, azure and crimson, on ivory; reproduced in the papers. The B.B.C. now has a coat of arms. The liberties of British listeners are secured and we can sleep at peace in our headphones.

I am afraid that our B.B.C. is a conservative body, although its chief engineer

went to the Washington Radio Chautauqua. Somebody there must have stepped on his gas; because he came back so brisk-moving that they now have to work him on a dash-pot. I do not know the American for "dash-pot," so it's a case for an editorial foot-note. (*The engineering term is the same over here, we believe*—EDITOR.) Shall I say instead, that they have to give his grid a heavy biasing voltage and fill his pockets with leaden shot.

Conservative is too mild a term. I might with propriety say "retrogressive." For instance, the B.B.C. is singing an oratorio about what it calls its new "regional scheme" of stations. This precious scheme —it's a plot!—aims, in effect, at the encouragement of the use of the crystal detector. Fact! They say that, because the man who can afford only a crystal receiver has to pay as much for his license as the Croesus who uses 14 valves, he is entitled to the fullest benefits of the service. "Benefits" is good. However, the logic is unassailable—provided it be first postulated that users of crystal sets are not public menaces. Which is absurd!

Ah, but here I smell class warfare—a diversion unknown, of course, in your country, where even a common banker, as R. L. Stevenson called 'em, is as good as a plumber. I hope you know what I mean by "plumber." (See *plumbum*: lead; whence, "leaden-footed," especially during a severe frost.)

My point is that only our middle class and our aristocracy are poor enough to use crystal sets. When we hear a fellow (gink or guy) speak of his many tubes, we look to see the marks of labor on his hands, or ask him how the brick-laying profession is jogging along. (*Note. In America, I believe, to marry into a bricklayer's family is equivalent to finding an oil-gusher in the back yard. In England it is social suicide; unless the bricklayer be unemployed, when he is a pensioner of the State.*)

In England, the (so-called) middle class, is, as its name implies, that stratum of society which exists miserably between the upper and nether mill-stones; the "upper" being the tax-collector and the "nether," the *cause* of the tax-collector (*i.e.*, the loafer.) The middle class is the milch-cow of society; too proud to apply for state relief; too respectable to beg; too stupid to steal; too idiotic to be shoved into an asylum for the insane; and too religious to wear a dirty collar. All it can do is use a crystal set, chop off kings' heads when necessary, pay national debts, and keep the country's honour clean.

In another article I hope to make you acquainted with the genuine British radio-fan, his exploits, his pretty lies, his weaknesses and his strong points. There we shall meet, I think, on common ground, and shake fins across an ocean of ignorance that has got to be mopped up. That is as fine a bit of mixed metaphor as was ever produced by a man of good will titillated by an emotion too human to heed the scruples of a grammarian.

Before I cut off the juice for this shift I will say this: When there's a millivolt lacking on the grid the whole world's akin; the wop condoles with the dago, and the squarehead (or Deutscher) with the **chee-chee*. Radio is the real League of Nations.

* *Author's Note*: Chee-chee is the Anglo-Indian colloquialism for "half-caste."

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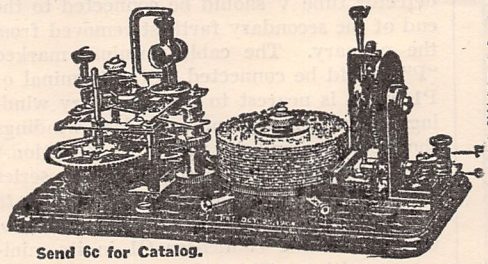

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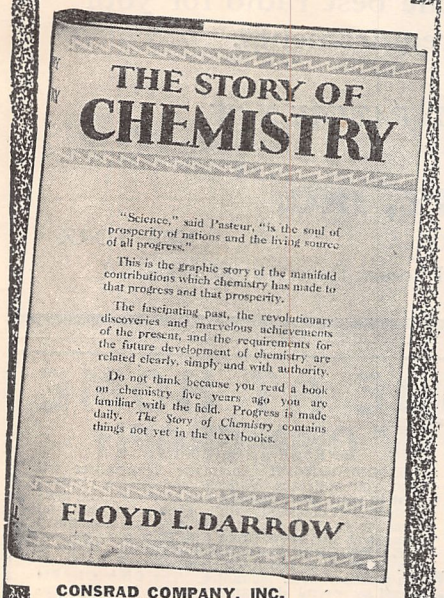
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R. F. Booster Unit Improves DX

(*Continued from page* 1239)

CONSTRUCTION OF THE UNIT

The wiring of the Booster Unit and the constructional details thereof are next in order. The pictorial diagram shows the wiring of the unit in detail. The circuit arrangement is not quite as simple as it first appears, for an audio choke (L2), and audio by-pass condenser (C3) confuse the issue somewhat; yet the entire arrangement is easily explained and more easily hooked up. It must be remembered that the radio-frequency component in the regular detector plate circuit of the receiver must be brought out and employed. This is done through the cabled wire leading directly from the plate terminal of the socket. This wire leads to the primary in the tuned-radio-frequency transformer (L1) in the Booster Unit. The other end of this primary must lead back to the "B" battery.

Now, the only possible manner in which to pick up "B" battery voltage by means of the plug-in unit is by means of a connection run to the plug's plate prong, which, in turn, connects to the high side of the primary of the first audio transformer. This explains the reason for the audio choke and condenser, as only the D.C. potential from this transformer is desired. The audio-frequency currents, flowing down through this winding from the plate of the new detector added in the Booster Unit, must not find their way back, nor become mixed with the audio currents set up in the plate circuit of the tube which previously acted as the detector in the radio receiver. The choke and the by-pass condenser accomplish this important task.

COILS OF THE UNIT

The tuned-radio-frequency transformer (L1) in the Booster Unit is built in the conventional manner, with sufficient turns on the secondary to cover the broadcast range from 200 to 550 meters with the tuning condenser employed. The primary winding is wound in two sections—one, (P1) a stator winding and the other, (P2) a rotor winding. In the unit herewith presented, the transformer is 2½ inches in diameter. The secondary (S) is wound with fifty-three turns of No. 37 D.S.C. wire. The stator winding (P1) of the primary consists of nine turns of the same-sized wire, spaced ⅛-inch from the secondary. The rotor section (P2) of the primary has five turns of the same wire—two and a half turns on each side of the central axis.

For best results, the grid of the Booster's detector tube V should be connected to the end of the secondary farthest removed from the primary. The cable terminal marked "P" should be connected to the terminal of P1 which is nearest to the secondary winding. (The primary and secondary windings should be wound in the same direction.) The rotor P2 is then connected in series with the stator P1 in such a way as *to oppose or stop oscillation at the short waves,* with the tuning condenser C1 in its minimum position. These few rotor turns will then aid at the long wavelengths, with the condenser in its maximum position. Of course, a tuning condenser with an extended shaft will be necessary in order to connect together, mechanically, the rotor of the condenser and the rotor of the primary.

Of course, a grid leak R and a grid condenser C2 are employed in the Booster Unit, as this circuit becomes the new detector. The return from the tuning condenser should go to one side of the filament. The two filament wires coming from the set are then interchanged in the tip jacks, for best results. By reversing these two filament wires the right polarity is ascertained; so that the grid return of the new detector will be on the proper side of the filament. This polarity is not a matter of extreme importance when using the UX-200A detector; although such a tube will give best results when the grid return is connected to the *negative side of the filament.* If a hard (amplifying) tube is used in this detector stage, it is quite necessary that the filament wires be so connected that the grid return will be on the *positive* side of the filament. However, the UX-200A, or soft detector tube, is unconditionally recommended for this unit. The dial-illuminating light (DL) is merely connected across the filament posts of the tube socket in the unit.

OPERATING THE UNIT

It is quite easy to recalibrate the tuning dial so that it will read in wavelengths, rather than in the arbitrary numbers usually found on tuning dials. *This calibration will be entirely independent of that of any receiver on which the unit may be used;* it depends solely upon the tuning condenser and the coil used in the unit. Thus this dial becomes a wavelength indicator and, though it is not at all critical in its tuning, gives a very good indication as to the wavelength of the station being received. In ordinary operating practice, the unit is first set at the wavelength desired, and the receiver is then tuned in the same manner previously employed. It will be found that the dials on the receiver have become considerably sharper, while the wavelength dial on the Booster Unit remains conveniently broad.

If it is desired to use the frequency-changing principle, the only change in design necessary is to remove a little more than half of the secondary turns in the Booster secondary; the number should be reduced from 53 to about 24. This unit will then tune only *the second harmonic currents;* which will give a 100% increase in selectivity, but reduce the distant pick-up somewhat. It is extremely easy to change your unit from one form to the other in order to determine just what is best for your particular location.

A complete list of the apparatus required for the construction of the R.F. Booster Unit follows:

One aluminum stage shield, 5 x 6 x 9 inches;
One wooden baseboard, 4½ x 8½ x ¼-inch;
One variable condenser, .0003-mf., C1; extension-shaft type for tickler mounting, with ¼-inch coupling;
One variocoupler (home-made—see text), L1;
One audio choke coil, 30-henry, L2;
One by-pass condenser, ¼-mf., C3;
One mica grid condenser, .00025-mf., C2;
One grid leak, 3-megohm, R;
One vacuum-tube socket, V;
Four tip jacks;
One binding-post strip, 4 x ¾ x 3/16-inch;
One illuminated dial;
One 200A-type vacuum tube;
One tube base and socket for plug, A and B.

A New System of R. F. Amplification

(*Continued from page* 1243)

3B, C, D:) The separate "A" battery method (Fig. 3B) is practicable only with low-consumption tubes of the 199 type, which are not the best for the system here described. The radio-frequency-choke method (3C) is effective, but bulky and expensive. The best by all odds is that shown in 3D, in which the filament of the tube is fed through a dual tuned choke, which is, at the same time, a part of the radio-frequency transformer.

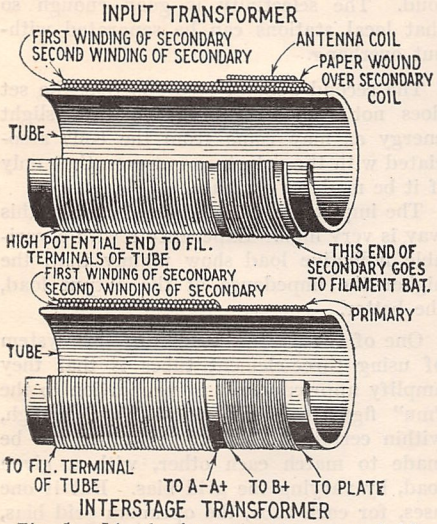

Fig. 5. L1, the input transformer, and L2, shown below it, must be carefully wound. A and B of L3 are spaced ½-inch apart. Use acetone and celluloid to cement the secondaries in place.

This system has been put into use by the writer with interesting results. At the time of writing the circuit which is operating the loud speaker is that shown in Fig. 4, consisting of two stages of tuned-plate-coil radio-frequency amplification, a regenerative detector, and one stage of transformer-

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Special to The New York Times.

SEATTLE, Wash., July 2.—Radio telephone communication has been established between Seattle and Australia, setting a new world distance record. This was announced today by Frederick G. Simpson, Seattle engineer and owner of Station 7XF in the Grand Trunk Dock.

A two-hour voice conversation was held by E. J. Lesser, manager of the Simpson Radio Corporation, and J. W. Robinson, an Australian amateur. Robinson lives at Concord, about 200 miles from Brisbane. His station is 2RN.

The distance, about 8,000 miles, is the longest over which a two-way conversation ever has been conducted. It is all the more remarkable because the power was only 100 watts. Most broadcasters, with ranges of a few hundred miles, use from 1,000 to 5,000 watts. The wave length of both Seattle and Australian stations was 38 meters.

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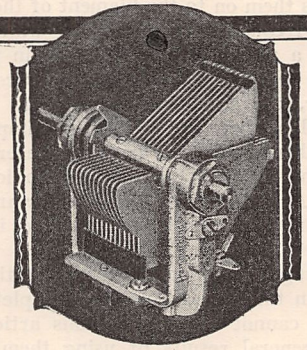

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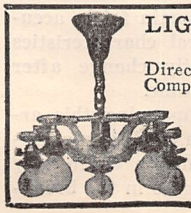

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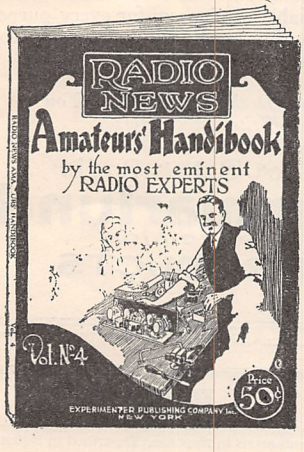

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coupled audio. The constants of the circuit are also given in Fig. 4. Details of the radio transformers, the only parts that are not standard, are given in Fig. 5.

The tubes used are standard—the high-mu type for the radio-frequency stages and the 201A type for the detector and audio circuits. Voltages in use just now are 100 for the R.F., 50 for the detector, and 150 for the A.F.; with grid biases of 7 for the R.F. and 17 for the A.F.

FUNCTIONING OF THE CIRCUIT

Tracing, now, the course of the signal through the receiver: Coming through the aerial-ground system, the radio-frequency impulses are sent into the cathode (here the filament) of the first tube by means of the double-conductor secondary of the input transformer. They act on the filament in the same way that, in ordinary practice, they would affect the grid of the tube. In this set each grid is grounded through the "C" battery, and controls the output only as it keeps the space charge close to the filament. It eliminates, also, the inter-electrode capacities in the tube between the leads except those in the stem and base.

The radio-frequency impulses, carried by the electronic stream to the plate, pass into the *tuned primary* of the interstage transformer. Its double-conductor secondary passes them on to the filament of the second radio-frequency amplifier, in which takes place a process similar to that in the first tube. From the plate of the second amplifier, the amplified impulses go into its plate load, here a straight tuned impedance; and thence via the grid condenser to the grid of the detector, and the audio amplifier. As will be seen, the detector and audio portions of the set are standard in every respect.

Though exact measurements of the tubes used in this way are not yet completed, and hence cannot be given in this article, certain general results of using them in this way can be given.

The first is, that the radio-frequency amplifiers, no matter what type is used, *do not oscillate;* even when, as in the set described, no shielding and other special precautions against feed-back are employed. The set-up shown, which is by no means the last word in design or efficiency, is sufficiently sensitive so that, on a fifty-foot antenna, strung about the moulding of a second-floor room in a section of New York pretty well shielded by fifteen-story apartment hotels, nearly all of the local stations come in with living-room intensity on the loud speaker, and even a few of the more powerful out-of-town ones, such as KDKA. As I stop a moment to see what I can get on 'phones, KYW comes in comfortably loud. The selectivity is good enough so that local stations can be separated without overhang.

The second general result is that the set does not radiate, except for such slight energy as may come from the coils associated with the detector, and even then only if it be made to oscillate.

The impedance of any triode used in this way is very high. Experiments with a variable inductive load show plainly that, the higher the impedance of the output load, the better.

One of the curious results of this system of using three-element tubes is that they amplify approximately in proportion to the "mu" figured in the usual way; though, within certain narrow limits, tubes can be made to match each other, with a given load, by varying the grid bias. But if one uses, for each tube, the optimum grid bias, output load, etc., the ear as well as instruments detect the greater value of the higher mu.

A word of caution should, perhaps, be spoken. The set described is a purely experimental affair, and gives, in fact only fair results. The time is not yet ripe to publish a "constructional article" on a set using this method. The method, however, opens possibilities for tube design as well as in the design of apparatus that may lead to something of value to radio.

A Buzzer R. F. Oscillator

(*Continued from page* 1249)

shocked into oscillations at its natural frequency by the impact excitation.

A CONVENIENT INSTRUMENT

Probably the most valuable use of a buzzer oscillator is for the purpose of a wavemeter. When it is used thus, the frequency of the oscillations which it generates must be adjustable, and this is accomplished by substituting a variable unit for either L or C. Although it is entirely possible to use a variable inductance (variometer) and a fixed condenser, the fixed inductance and variable condenser combination is usually employed. This is because the calibrations of the latter are apt to remain fairly accurate; whereas the electrical characteristics of a variometer frequently change after it has been used a short time.

The two pictures accompanying this article show the construction of a simple, efficient buzzer-excited wavemeter which may be adjusted to all wavelengths in the broadcast band. The unit is mounted on a panel 6 x 7 x 3/16 inches and may be placed in a cabinet 5 inches deep. The essential parts required for its construction are: one .00035-mf. variable condenser, one coil 2½ inches in diameter and wound with 60 turns of No. 26 D.C.C. wire, one high-frequency buzzer, one rheostat, one 4½-volt flashlight battery and one tuning dial. The parts may be mounted as illustrated in the pictures; and wired as shown in Fig. 3.

After the construction of the wavemeter has been completed it should be calibrated. The best way to do this is to tune in a station of known wavelength on a broadcast receiver, set the wavemeter in operation and place it near the antenna coil of the set; then adjust the dial of the wavemeter until the signal of the buzzer is heard loudest in the loud speaker. The wavemeter is now adjusted to the wavelength of the station which is being received, and the dial reading should be recorded. This operation

should be repeated with several stations, until sufficient data have been obtained to plot a graph. If care is exercised in making adjustments, this method of calibrating a wavemeter is sufficiently accurate for most purposes.

In the diagram a fixed condenser is shown in dotted lines (X) connected across the contact points of the buzzer. This, often, will greatly improve the operation of the wavemeter by preventing sparking at the points of contact. The condenser should have a capacity of 1 mf. It is also possible to farther improve results by connecting a 0-200-ohm variable resistor in series with the condenser and carefully adjusting the value of the resistor until all sparking is completely eliminated.

Building a Dynamic Speaker

(*Continued from page* 1247)

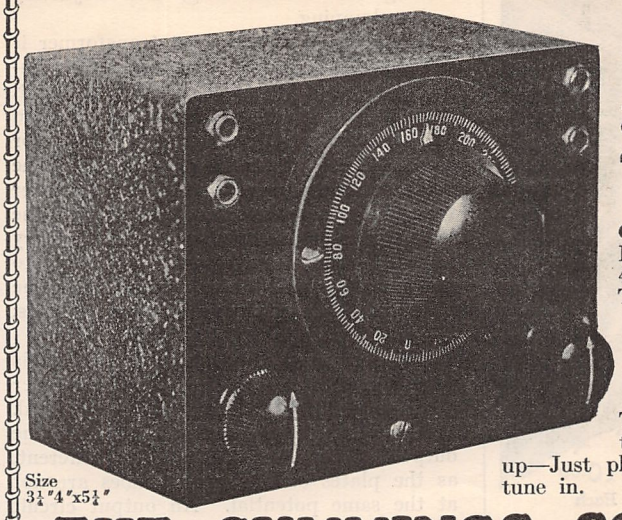
Before the flexible support is glued to the cone, it should be glued to a five-ply-veneer wooden ring which is ½-inch thick, 7½ inches inside diameter, and 9½ inches outside diameter. Here liquid glue is again used. After this the inner edge is glued to the cone, as explained above. The wooden ring is fastened to the baffle by four screws. The holes for these screws in the ring are made somewhat larger to allow for adjustment, washers being used under the screw heads to hold the latter from drawing into the holes.

The baffle is made of five-ply wood veneer, ½-inch to ¾-inch thick. It is fourteen to eighteen inches square and has a hole in the center, 7½ inches in diameter.

ASSEMBLY

The following procedure is used in assembling the speaker: the baffle is laid flat upon a table, and the cone, mounted in its wooden ring, is placed concentrically on it with respect to the hole in the baffle. The cone is then clamped to the baffle with the four screws in the wooden ring, as explained above. The field electromagnet, with its three brackets and the armature coil mounted on its bridge, is placed in position and adjusted so that the apex of the cone comes in the center of the double spiral mounting the armature coil. Then the locations for the three wood screws, fastening the brackets to the baffle, are determined and the brackets are fastened in place to the baffle with these screws.

The speaker is then placed in its proper position and the apex of the cone is cemented to the double spiral as follows: the bolt fastening the armature coil to the spiral will extend through into the apex of the cone; and the apex and bolt and spiral should all be securely fastened together with household cement. After the cement has thoroughly set, the speaker is ready to try out. Sometimes we find that it is still necessary to make minor adjustments, because of the armature coil's striking the field magnet poles. This adjustment is accomplished by slightly loosening the clamping of the double spiral in its bridge mounting and adjusting the spiral so that the buzz is eliminated. Any adjustment of the cone for alignment at the larger end is done by loosening the four screws



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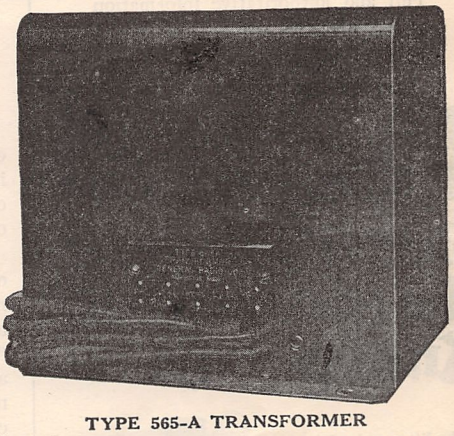

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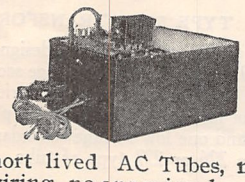

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holding the wooden ring, then adjusting and reclamping.

The primary of the input transformer is wound with very fine wire, probably number forty, and, to avoid possible burnout, the battery current should not be permitted to flow through it. A filter circuit for accomplishing this is shown in Fig. 5. The primary impedance of the input transformer for the speaker varies directly with the load, which is applied to the secondary when the input transformer is connected to the armature coil. The impedance at one thousand cycles is nine thousand ohms. The winding ratio is thirty-three to one.

For best results with a speaker of this type, a push-pull amplifier using two power tubes in the last stage should be employed. When an amplifier of this type is used the output circuit must be slightly different, as the plates of the output tubes are not at the same potential. An output circuit which may be used with satisfaction is shown in Fig. 6. In this diagram L1 and L2 represent two choke coils, having an impedance of not less than 30 henries each at 30 milliamperes. The condenser C1 should have a capacity of approximately .001-mf.

Suggestions for Power-Amplifier Current Supply

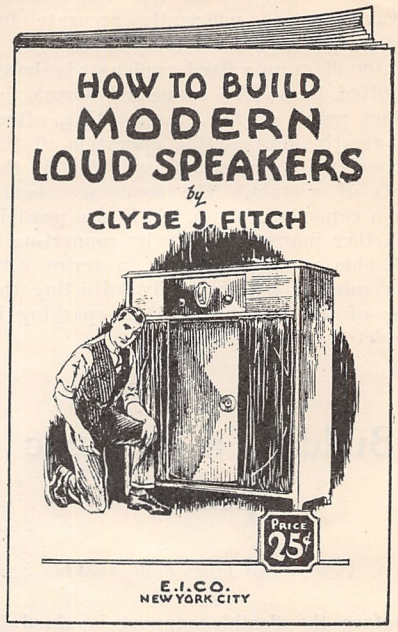
(*Continued from page* 1247)

curing a power-tube adapter. Those desiring to make a permanent connection should couple the "C" battery into the grid circuit of the last audio tube.

If an examination of the last transformer, or double-impedance unit, is made, it will be noted that the two terminals of the secondary, usually designed by the symbol "S," or "Sec.," are marked "F," meaning filament, and "G," meaning grid. The wire connected to the terminal "F" should be disconnected from the transformer and connected to the positive, or "B+" terminal of the "C" battery. Another lead should be run from the negative, or "B—" terminal of the "C" battery to the transformer post marked "F," thus completing the circuit. In the case where single-impedance or resistance coupling is employed, the "C" battery should be connected to the grid leak at the side farthest from the grid of the tube. The negative side of the "C" battery should be connected to the grid leak, and the positive side to the ground, the original connection between these points being, of course, broken.

Because of the fact that the "B" batteries, used to boost the output voltage of a power unit, are required to serve but one tube, many months of service can be expected before the end of their useful life is reached. Where the potential applied to the plate of the UX-171A is 135 volts, the current drain, with proper "C" bias, will be 18 milliamperes; where 180 volts is applied to the plate, the drain will be about 20 milliamperes. It is thus seen that the current drain is not substantially altered in either case; and for this reason it is as economical to use two boosting batteries as one, and thus enjoy the maximum power output of the power amplifier.

The above suggestions apply equally well to "B" power units operated from alternating current, but which, for various reasons,



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do not have sufficient output voltage for the satisfactory operation of a power stage. It often happens that an A.C. power unit, particularly one of the older type which may have given good results in connection with tubes of the 201A type, fails to give the expected results when connected to a power tube. This is due to the relationship between current drain and voltage, because, as the current increases, the voltage drops rapidly. Consequently, some power units, having a rated output of 135 volts when used with 201A tubes, may have far less than that when used in connection with a tube requiring a comparatively high current. In this case, boosting batteries may advantageously be used, and should be connected precisely as in the case of the D.C. eliminator.

The Eveready Hour

(*Continued from page* 1218)

WEAF with a consistent, comprehensive schedule mapped out.

How much their broadcast activities have grown since then may be realized by a comparison of the first year's radio costs, which totalled $3,850, although the original appropriation had been $500, while this year's appropriation which is $400,000. Then there was but one station and a small listening public; now there are thirty-one stations and uncounted thousands tuned in.

It is true that from the start the National Carbon Company was fundamentally interested in selling batteries, and its success in that respect is contemporary business history.

With this commercial purpose of exploiting its own product in a legitimate manner, the Eveready makers wanted their radio activities to reflect that imaginative quality which, they believe, marks the successful business man or company. The Eveready Hour has been their expression of this quality, of an imaginative and mysterious character which distinguishes radio. Its purpose has been to provide the most enjoyable entertainment to the greatest number of listeners. The policy of the backers of the Eveready Hour has been: "That it may always be entertainment of the highest type, irrespective of the key or mood in which it happens to be given." So that all classes and types of listeners might be pleased, and realizing that it is an impossibility to please all the audience all the time, Eveready has presented diversified programs, has experimented in various fields and, because of the thoroughness and care with which these experimentations were made, they have many, many times been taken as a criterion by other broadcasters.

A STORY FROM LIFE

What is generally regarded as one of the finest programs ever heard on radio is "Galapagos," with Martin ("Red") Christianson, which has already been broadcast four times.

The staging of this program is an interesting story in itself. Mr. Furness was reading a book by William Beebe, describing the author's trip to Galapagos, when he became interested in a chapter devoted to an unusual experience of the explorer.

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EASY TO ERECT

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Aerials contain 350 feet of coiled wire

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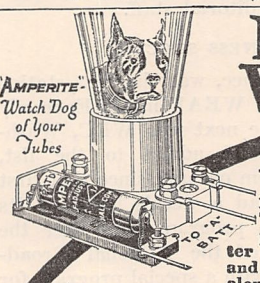

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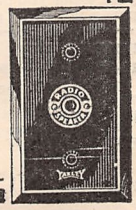

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DEALERS

See page 1292

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Have hundreds of uses. Every amateur should have two or three of these amplifiers in his laboratory.

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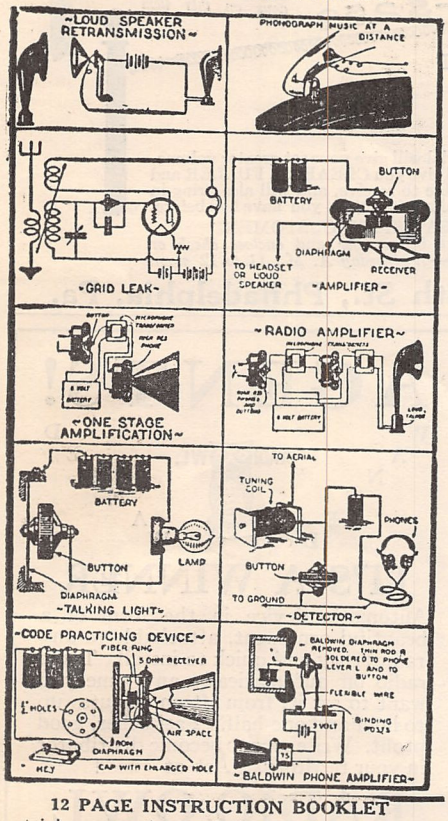

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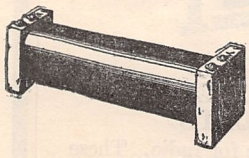

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Please mail me at once.....Skinderviken Transmitter Units, for which I will pay the postman 95c., plus postage, or $1.75, plus postage, for 2 units.
Please ship me one P. G. Microphone Transformer, for which I will pay the postman $2, plus postage.

Name.....

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It concerned a chance meeting with another adventurous soul, who had once been shipwrecked on Galapagos, but whom he had found driving a taxi in New York. The chauffeur's name was "Red" Christianson. Mr. Furness commenced a search for the man, located him through Mr. Beebe, and then Mr. Stacey arranged the famous "Galapagos" broadcast. Letters poured in from all over the country; program authorities proclaimed it to be the best thing of its kind ever done; different cities begged for visual staging of it and, whenever it has since been repeated, the reception has been similar.

The "Golden" anniversary was another popular program which was heard on this hour and represented the first actual use of the continuity idea in broadcast programs. It held the thread of a drama in which the directors introduced music that was popular half a century ago.

During 1924, while the N. B. C. was realizing how important their radio activities were, Wendell Hall was their most popular artist. That was before the time of chain-station broadcasting and the company sent this music-maker on a planned tour of all the existing stations, spreading the Eveready message. Later he came back to WEAF and, in the first radio wedding, was married to Marion Hall, a member of the *Chicago Tribune* editorial staff.

A BUSINESS SUCCESS

WJAR, Providence, was the first station regularly added to WEAF in the Eveready broadcasts and the next was WRC, Washington. As WEAF added to the list, Eveready took them on and, since that first hour, has never had a week's break in its record. Now the program goes over the regular network of the National Broadcasting Company with a special program for the Orange chain on the Pacific coast; while the Canadian National Carbon Company is active on individual Canadian stations, such as Montreal, Vancouver and Toronto. The eastern office alone, using twenty stations, spends $325,000 a year.

We were anxious to learn just how definitely the National Carbon Company can trace its development to broadcasting and we asked Mr. Furness if he knew that his company obtained enough direct sales to justify the enormous expenditure which is being made this year. He agreed that it is difficult to check just what direct sales are attributable to broadcasting; but he used his company's survey of its activities in southern states as an example.

The Eveready program went on the southern stations in January of last year. The company knows definitely that its business increased more than enough to warrant its continuing. Sales territories were divided into sections, separating the zones of radio influence from that part of each territory which was not receiving the broadcast programs effectively. The business where regular reception was checked showed a big increase over that part of the south which was not being covered by Eveready programs.

Opera, chamber music, jazz, minstrel shows, vaudeville, drama, lectures and novelties have gone into the making of the Eveready Hour on the air. Four years, fifty-two times a year and never a flop! If this isn't an enviable record, then radio can't offer it. There have been degrees of success, naturally; some hours have been better than others; but, without exception, the Eveready hour has adhered to high standard of consistency in air entertainment. The public knows what it has been getting, and the coming months will but add to the general appreciation.

Building a Linen-Diaphragm Loud Speaker

(*Continued from page* 1248)

The next operation should be performed either outdoors or in a room with the windows open, as otherwise the fumes from the collodion are liable to cause an unpleasant sensation. Paint the face of each diaphragm with the thin collodion and allow it to dry. Four or five coats are required; *let each coat dry before applying the next one.* When the last coat is dried the diaphragms will be stiff and slightly flexible and, when tapped with the finger, will sound like a drum.

The small coupling bolt is next prepared. This is an 8/32 bolt, ½-inch in length, through which is drilled lengthwise a small hole, just large enough to take the driving rod of the loud-speaker unit which is to be used. One of the washers is put over the bolt and the head with the washer is put through the hole in the large diaphragm, from the front. The two diaphragms are forced together until the bolt can be slipped through the hole in the smaller square, after which the other washer and the nut are put on and tightened down.

The mounting of the unit itself is left to the ingenuity of the constructor. The method employed with good results by the writer can be seen in the accompanying illustrations. It is important to remember that the unit must be so lined-up that the driving pin will come exactly in line with the hole in the bolt.

The finished speaker may be placed in a cabinet or hung from the ceiling. If it is desired to color the linen diaphragms this must be done before treating them with the collodion. The tacks should be covered over with an attractive passe-partout binder for appearances' sake.

The material needed for constructing this speaker is as follows:

4 pieces of cypress, 24 x 2 x 1½ inches ("A, B");

2 pieces of cypress, 24 x 1½ x 1 inch ("C");

2 pieces of cypress 7½ x 1½ x 1 inch ("D");

4 triangular pieces cypress 1½ x 1½ inches ("E");

2 squares of medium-weight linen, one 26 x 26 inches, and the other 8 x 8 inches;

4 1¾-inch woodscrews ("F");

2 ½-inch washers ("G");

A ½-inch 8/32 brass screw and nut ("H");

A package of No. 4 cut tacks;

A roll of passe-partout binder:

10 oz. collodion (Obtainable at drug store) or varnish;

A balanced-armature loud-speaker unit with driving rod ("P").

Editorial Policy Ballot

(See Page 1208)

Editor, RADIO NEWS:

I vote for changes in editorial policy as follows in the space given to different subjects in the pages of RADIO NEWS, as shown by the squares which I have crossed below. I am satisfied with the present policy in respect to all other subjects.

Please fill out and mail to Editor, RADIO NEWS, 230 *Fifth Avenue, New York, N. Y. (U.S.A.)*

More	Less	GENERAL ARTICLES
☐	☐	Pictures of Broadcast Artists
☐	☐	Descriptions of Broadcast Features
☐	☐	Interviews with Broadcast Artists
☐	☐	Courses in Musical Appreciation
☐	☐	Pictures of Broadcast Stations
☐	☐	Illustrations of Radio Novelties
☐	☐	Editorial Talks
☐	☐	Radio Fiction—"Human Interest"
☐	☐	Radio History and Biography
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☐	☐	Radiotics
☐	☐	Broadcastatics
☐	☐	"The Listener Speaks"
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☐	☐	Radio Fiction—Semi-Technical

More	Less	TECHNICAL ARTICLES
☐	☐	First Principles of Radio
☐	☐	Radio Work for Beginners
☐	☐	What's New in Radio
☐	☐	"I Want to Know"
☐	☐	Constructional Wrinkles
☐	☐	Correspondence from Set Builders
☐	☐	Broadcast Station Lists
☐	☐	RADIO NEWS Laboratories
☐	☐	Semi-Technical Radio Articles
☐	☐	Circuits with Constructional Layouts
☐	☐	Foreign Radio Activities
☐	☐	Short-Wave Reception Data
☐	☐	Experimental Circuits (without layouts)
☐	☐	Television and Picture Reception
☐	☐	Short-Wave Transmission (amateur)
☐	☐	Advanced Radio Theory

I would like to suggest these additional subjects for early treatment, or new departments:

.....

.....

If you do not wish to sign, please place an X here if you are a woman reader ☐

(*Signed*).....

(*Address*).....

.....

"Television"

THE debt I owe to radio,
I know I cannot pay.
And now there whispers down the wind,
A wonder due today—
It's all that television plan,
(Confusing, I confess);
I hope to see that "Magic Isle"
The "Wrigley Spearmen" stress.

I hope the vision may be clear,
When Tiny "X-Ray" speaks;
And who can voice the charm there'll be,
In Clark's Hawaiian peaks?
Of course we'll love that Forest scene,
In fair "Sylvania's" wood;
We'll speechless gaze on "Rose Bowl" haunts,
Where Graham proudly stood.

We'll watch La Prade ascend the Alps,
And sail the Baltic sea;
And on Bermuda's coral strand,
We'll long with him to be.
We'll be the "observation guest,"
In presidential halls;
And cheer the "Homers" on the plate,
And see who fouls the balls.

We'll peep in Gen'ral Motors' plant,
And note which Klaxons cry.
We soon may follow Lindy's course,
And vision him on high.
With television on the way,
(Nor yet beyond its goal),
We hope to see our honored Byrd
When he o'ertops the Pole.

—*Viva Snow.*

TRY THE SIDEBOARD AND GET CHINA

FIRST RADIO FAN: "I used bicycle spokes for an aerial, and got Wheeling."

SECOND RADIO FAN: "That's nothing; I put my loud speaker on the bed and got Davenport."

Mrs. Bill Howard.

KNEW THE SYMPTOMS

MR. JONES (to MRS. JONES): "I've got such a strange humming noise in my left ear."

LITTLE BENNY JONES: "Maybe it's your batteries charging, daddy."

—*Mrs. H. Gersten.*

NEED FOR FINESSE

One of the hardest bridge problems on the radio is to keep it tuned out.—*Judge.*

Achieve SUCCESS in Radio

New course gives finest instruction obtainable

You Can Learn at Home!

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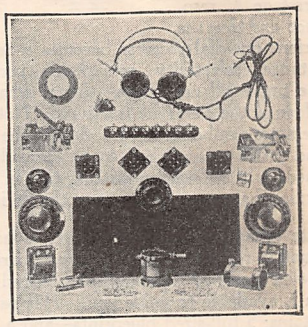

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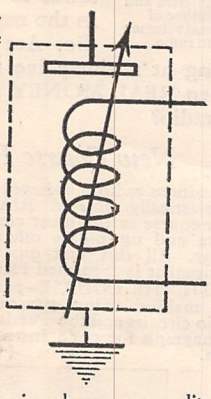
Build An efficient ONE DIAL RECEIVER Use the PERIDYNE Designed by HUGO GERNSBACK



An efficient one-dial set can now be built with a unit designed by Hugo Gernsback, well-known inventor and publisher. The Peridyne, as this unit is called, employs an entirely new principle in operation. Due to the new principle that it involves, the Peridyne assures positive, true interstage resonance and thus the efficient one-dial receiver becomes a reality. Distance, selectivity remarkable performance under all conditions—this is what the builder of the Peridyne is assured. Note the schematic symbol used to designate the Peridyne. This symbol had to be specially designed, as there was no existing sign in radio practice that properly identified the Peridyne.

Write today for complete constructional information for the building of this remarkable one-dial receiver. A complete Consrad Pattern is available to guide you. This pattern contains: 5 full-sized blueprints—and a large magazine size instruction booklet. All the information necessary to construct the efficient Peridyne Receiver will be found in this set of plans.

Write today—do not hesitate

COMPLETE PLANS **50c** ONLY

Build this set and prove to yourself the merits of this circuit.

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Gentlemen: Enclosed find 50c., for which please send me full Peridyne plans.

Name .....

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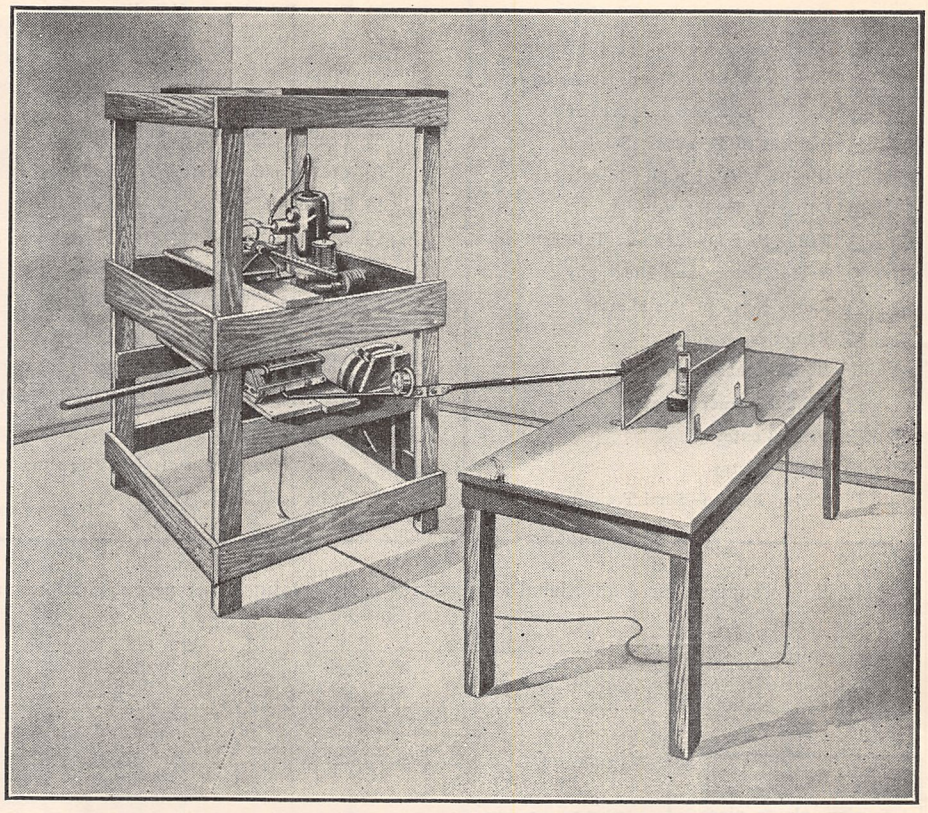
City ..... State .....

High-Frequency Magic in the Radio Laboratory

(*Continued from page* 1205)

at the end of a wire without any visible return circuit. Smaller standing arcs have been established on the ends of a receiving aerial several feet distant from the transmitter, showing that it is possible to transmit power currents through space.

What are the uses of a tube of this nature, besides transmitting radio signals, is difficult to judge. Will it be possible to transmit power over many miles instead of a few feet? Will this device fill some long-felt want in the medical profession? Will it



When a tube of water is placed between two parallel plates, connected to the 6-meter transmitter, as shown, the water boils after a few minutes.

Here is another most amazing plaything of scientists that astounds its beholders today, but to-morrow may seem to be as commonplace as a street-car or a balloon. eventually replace our kitchen stoves? No one can say at this time anything except "Here is something new. Let us see how we can use it to make life easier."

Handle Power Tubes with Discretion

WITH the increasing popularity of power amplifiers and power packs, radio has entered the power field, from the standpoint of the use of high-voltage equipment.

In many of the power packs employing rectifier tubes of the 280 and 281 types, for use with power amplifiers using the 210-type tubes in single or push-pull arrangements, the voltages supplied to the power tubes often run over 400.

In using such equipment no danger is involved either to persons or to equipment if ordinary common-sense precautions are taken in its handling. It is well to remember that, when dealing with such voltages, the current source should be turned off before any attempt is made to change tubes, equipment or wiring.

Pulling a 210-type tube out of its socket, for instance, while the current to the power pack and amplifier is turned on will cause a surge of voltage; which may be sufficient to charge the filter condensers of the power pack to the breakdown point, unless the condensers are designed to withstand very high voltages.

The usual result of a breakdown in the condensers is a decided heating in the rectifier tube, causing the tube elements to become red hot. This will ruin the rectifier tube if not discovered in time and may even result in sufficient heat to break the glass of the tube. Such heating of the tube is no fault of the tube's design, but it is a sure indication that there is something wrong in the power-pack equipment or wiring.

From Paul Revere to Paul Whiteman

(*Continued from page* 1241)

buried treasure came to mind. Visions of another captain also, Captain Morgan, the most famous—or rather infamous—of all buccaneers, were recalled. Tales of the Spanish Main with buried loot and hidden pelf loomed up.

A whole afternoon and half of a night was spent gouging out the inlay outlining the small panel and then steaming it over the family teakettle, until the gas bill ran double for the month.

His patience was finally rewarded by the liberation of three separate papers carefully folded and embedded in the pocket, over which the panel had been sealed into place with glue. Some unavoidable damage was done in steaming out and opening the folded slips; but enough remained to show what purports to be an old formula in a fair state of legibility.

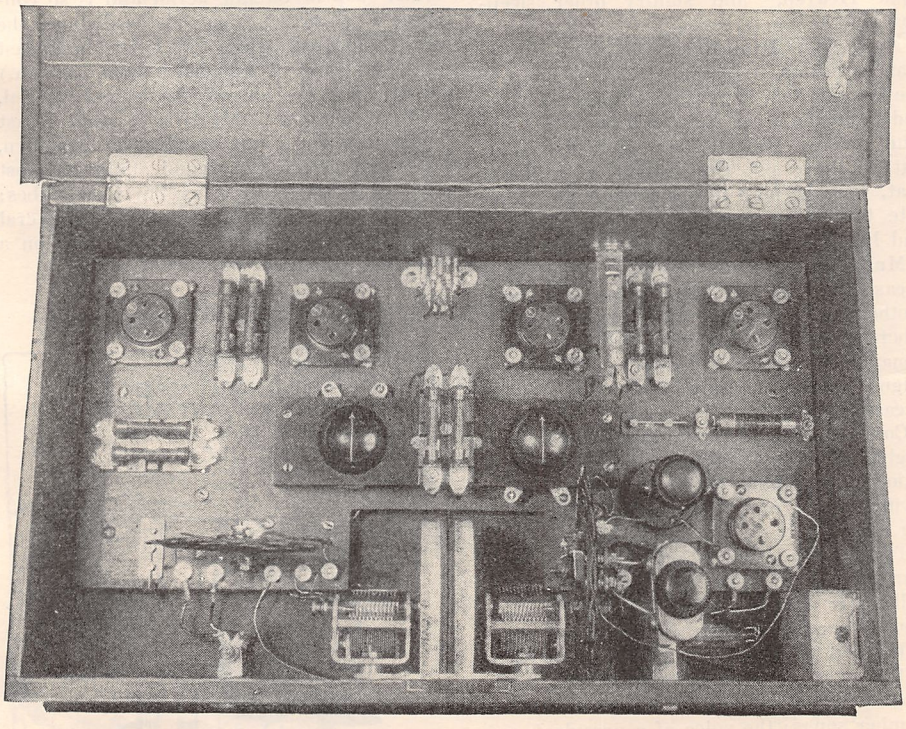
A MYSTERY UNSOLVED

The date January 26, 1791, appears on one of the papers, along with some cryptic figures and letters apparently in code formation. Several other names in three different styles of handwriting, and prices of grains, etc., apparently of that date or period, make up the remaining contents of the documents. The chest and papers have been shown to a number of antiquarians and collectors, and last summer, while the writer was in New York City, it was taken to one of the museums for examination. The opinion given was that this was a very unusual and hitherto unknown method of secreting documents or messages in furniture. Further, the thought was expressed that these seemingly simple and meaningless words, formulas, etc., were, in fact, some secret message in code.

Considerable time and effort has been spent in trying to establish the original ownership and authorship of the cabinet and of the papers found; as well as in deciphering and decoding the messages, if such they be, to learn the probable motive in secreting papers in such an inaccessible place and manner that only through the building of a modern radio were they disclosed 136 years later.

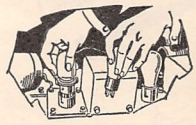
As previously mentioned, ownership of the Treasure Chest has been definitely established and traced back three generations. The lady who used it years ago as a jewel case evidently little suspected that anything unusual reposed within its walls, except her own gems which adorned her person; as the chest had been completely painted over before that time, thereby totally obliterating the design on the front panel.

The name signed to the formula is that of an old and well-known family who resided in Pennsylvania before and after the American Revolution. Two brothers served in that war and later migrated to Virginia. Later direct descendants include a distinguished physician and surgeon, who practiced in the latter state and who was also an inventor of considerable note outside of his own profession. According to authentic information, one of the earlier members of this family, before or during the Revolutionary period, returned to England and all subsequent trace of him was lost. However, a descendant of the above-mentioned family, now living, believes that possibly this Tory relative of Revolutionary times may have attempted to communicate with some one in the United States in this manner. Obviously, the message never reached its destination.



The modern radio equipment within contrasts strangely with the look of antiquity in the time-mellowed woodwork of the "Treasure Chest."

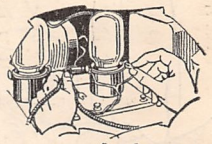
Electrify Your Set
WITH THE
MARATHON
A-C KIT
SIMPLE AS A-B-C



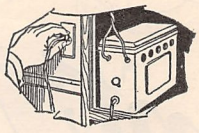
Marathon AC Tubes have the standard 4 prong UX bases. No adaptors or center tap resistors.

Replace your old Tubes with Marathon A-C Tubes

The Marathon harness is universal, and can be used in any set. The "spades" slip over the projections on the tube —no thumb screws.



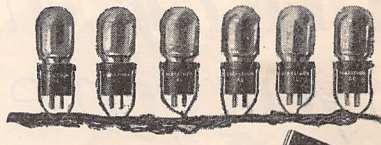
Connect the harness



Plug in the light socket
-that's all there is to do

One end of the harness connects with the Marathon Transformer. All tub s operate on one voltage—6 volts—so there are no taps. Simply plug the transformer into the light socket.

YOU CAN'T MAKE IT COMPLICATED



LIST PRICES
5 or 6 Tube Kit $30.00
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8 Tube $40.00
COMPLETE

Satisfaction Guaranteed

No need to wonder if the Marathon AC Kit will operate on your set —we guarantee it. If you have a 5, 6, 7 or 8 tube set using UX sockets and are now employing an "A" Battery (either dry cell or storage) you can use the Marathon AC Kit—perfectly. Marathon AC Tubes are guaranteed for a year. If your dealer cannot supply you use the coupon below.

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Nothing else to buy—everything is complete. For example the six tube kit includes 6 Marathon AC Tubes—a universal harness—a 6 volt Transformer—a volume control—and an instruction sheet. Anyone, no matter how ignorant of radio can change his set from DC to AC.

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New York World
Feb. 10, 1928
dent time.
It is one of the
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KILLED HER BRIDGE PARTNER
DETROIT, Feb. 9 (A. P.)—Because
her bridge partner played the wrong
card twice Mrs. Mary Lee Bishop shot
and killed her, it was testified to-
day at Mrs. Bishop's trial for murder-
ing Mrs. Rosa Lee Henderson. Mrs.
Bishop was sentenced to life impris-
onment.

Don't— let this happen in your home

BRIDGE— by Whitehead

THE REMEDY

Don't kill your bridge partner for making errors—give him a copy of "Bridge," by Whitehead—he'll then become a very valuable partner. Maybe the shoe is on the other foot? Maybe every time you play your life is at stake. Read this little book on Bridge, by Wilbur C. Whitehead, the renowned authority. Let this expert tell you how to play—complete instructions by a new, easy, illustrated method. Each phase thoroughly and understandingly treated. The best players can learn much from this book. The beginner could find no more able instructor. Large size 9 x 12 inch book—beautiful colored cover—100 pages.

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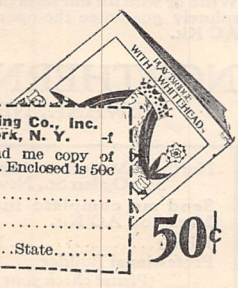

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Gentlemen: Kindly send me copy of "Bridge," by Whitehead. Enclosed is 50c

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50¢

A five-tube radio of rare quality has been installed in the old chest—all-resistance coupling. Now, you radio fans can appreciate just what that means: quality, supreme quality, as befits such a rare, beautiful and romantic cabinet!

While the writer has several other radio sets, he and his wife call this the T C or Treasure Chest Set, and believe it to be the most unique, romantic and truly antique-modern radio receiver now in existence. And to the antiquarian or connoisseur who is looking for something really different and not easily duplicated, the search is ended.

However, the "T C" is not for sale at any price.

IS IT HAUNTED?

Considerable difficulty was experienced in getting a comparatively simple hook-up to function properly, when actually placed *inside* the cabinet. When this circuit was tried *outside* of the chest, the performance was all that could be desired. But when the chassis, with its assembled wiring, was secured into position inside, a woeful succession of moans, howls and unholy screeches of an entirely new order, as of some lost or tormented soul, came forth. This persistence of sweet concord without, and rank discord within, for no apparent or known reason, almost led one to wonder if the chest were haunted.

Could it be that some irresponsible and incorrigible "Nell Gwyn" of the past had returned to protest this invasion of her jewel case? Was some vengeful Tory, loyal to the King, the sender of a message that boded ill for our colonists and balked in his efforts, long since useless, raging in impotent wrath at this etheric disturbance from modern "mikes" and jazzing bands? Or, could it be that some boon companion or confrere of our nationally-revered hero of a certain famous midnight ride, torn with the spirit of those turbulent days, was grumbling at having his sesquicentennial repose disturbed by such turmoil as "Reynard Strolls," "Baked-Bean Blues," "In My Pink Heaven," and sundry other sleep-destroyers?

Now, from Paul Revere to Paul Whiteman is quite a stride, not to say a jump of the imagination, the reader will admit. One rode, and the other rides well his "Pegasus" Our revered Revere knew not his radio; but we have not the shadow of a doubt that, were he here now, he would not hesitate to become a member of the modern and honorable order of dial twisters.

Music hath charms to soothe the savage breast. . . . The savage breast has been soothed. Did music do it? It has soothed others even more violent. But the fact remains that peace and sweet concord now reigns supreme within the walls of the Treasure Chest.

Could those walls talk, what stories they might tell of base intrigue, of soaring ambition; of gallant cavaliers and of curtseying dames, of powdered wigs and flashing beauty!

Tonight the syncopation of Paul Whiteman mingles with the stately minuet of the still more stately dames of the days of Paul Revere. The lilt of the sprightly tango is blended with the more dignified gavotte of the times of Washington and Dolly Madison; symphony and fox-trot, spirituals and slumber songs; the voice of a president and the bedtime tales of a sandman—all in tune with the memories replete with action and full of romance. The most modern of sciences is wedded to ancient craftsmanship after a century and a half of waiting.

TECHNICAL DETAILS

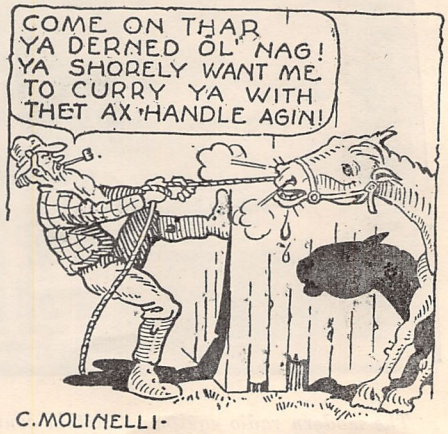
In these columns will be found the complete schematic wiring diagram of the receiver which was built in the Treasure Chest. The circuit used, in its present form, is one originally designed by the writer's good friend, J. E. Roberts, of Cleveland, Ohio, to whom much credit should be given for many helpful suggestions. In this particular case, it was necessary to modify the circuit and coil windings, type of condensers, and particularly the output device to suit existing requirements.

The receiver comprises a five-tube circuit, comprising two stages of R.F., one tuned, one untuned; a regenerative detector; two stages of reflexed A.F. and two stages of straight A.F. The reflexing, as shown in the diagram, is made through resistance units; which constitutes the unique and outstanding feature of the circuit, giving supreme quality, and the selectivity of most supers, without the harmonics of this well-known circuit, and magnificent volume.

When the interior constructional view was made, the variable resistor for controlling regeneration was attached to the detector coil. Later, as the idea developed, the writer considered that, having shown the key in its ancient keyhole, it would be quite in keeping with the general fitness of things and the artistry of the work, to devise some means whereby manipulation of the regeneration control could be effected by direct connection with the key, as shown in exterior view. Therefore, since the above interior view was taken, this variable resistor has been mounted on a small bracket just inside of the keyhole. This was accomplished by removing the knob and filing the shaft down to a driving fit to enter a hole in the key. By this means control of regeneration is effected, thus enabling one to carry out the idea of the key unlocking the melodies from the Treasure Chest.

The circuit was designed to work on either loop or outside aerial and is so constructed at present; but, at the distance the set is located from the large broadcast stations (it is at Shepherdstown, W. Va.) it functions better on the outside aerial, and the loop is rarely if ever used. Last summer, when it was operated in Brooklyn, N. Y., reception was found ample on most local stations, when using but three tubes; and Detroit, Michigan, was pulled in several times with faint loud-speaker volume on a loop with the same number of tubes.

RADIO TERM ILLUSTRATED



"Attachment Cord and Plug"

The New Neutroheterodyne Receiver

(*Continued from page* 1245)

secondary coupling, using detector regeneration, etc.; but these methods are not entirely satisfactory.

How, then, can we solve these two problems? Again the obvious answer is by means of the heterodyne circuit, which makes it possible to eliminate both difficulties at once without mechanical complication, and with an actual gain of amplification. By this means we reduce our tuning controls, electrically, to two dials and, since we amplify at only one frequency, the amplification is always uniform.

A SATISFACTORY DESIGN

Thus a careful consideration of both the superheterodyne and the shielded-neutrodyne circuits leads us to the same conclusion—the desirability of using a shielded tuned-radio-frequency amplifier, of about 450-kc., as the intermediate amplifier of a superheterodyne. This combines the selectivity and ease of tuning of the ordinary superheterodyne with the high amplication and excellent quality of the shielded neutrodyne; and at the same time it eliminates the bad features of both types of circuit. The stability of this shielded intermediate amplifier, together with the fact that the tuning of this part of the circuit is fixed, makes possible the use of regeneration in the second detector. The intermediate-frequency stages may be carefully neutralized and adjusted to resonance by means of adjustable condensers, and after that require no further attention. Only one initial adjustment of regeneration is necessary.

The only difficulty that is likely to be encountered in the design of such a receiver is the interference of code stations operating at or near 450-kc. The tuning of the first detector is not sufficiently sharp to prevent this completely. The use of a wave trap tuned to 450-kc., located in the antenna lead, together with complete shielding of the first detector and oscillator will, however, entirely eliminate this type of interference, should it occur.

The receiver developed by the writer employs a totally-shielded and neutralized intermediate-frequency amplifier tuned to a frequency of 461 kc., or 650 meters; its circuit is shown schematically in Fig. 3.

Amplification is increased to a maximum by means of fixed regeneration in the second detector. Two stages of high-quality audio amplification, with a 210-type power tube in the last, insure ample undistorted loud-speaker output. In order to prevent interference from local broadcast and code stations, and to prevent direct radiation from the oscillator, both the first-detector and the oscillator stages are shielded. Provision has been made for controlling the volume from any point away from the receiver, and for connecting a phonograph reproducer directly to the audio amplifier. The set uses seven tubes, and occupies a space of only 7 x 21 x 10¾ inches.

QUALITY AND DISTANCE

It has never seemed to the writer to be worth while to build up a receiver, however good it might be in all other respects, unless the quality was such as to approximate very closely that of the original transmission. Quality was, therefore, a primary consideration in the design of this receiver. The merits of the audio amplifier here used are so well known that it is hardly necessary to dwell long on this point. Suffice it to say that the rest of the receiver has been designed to prevent any possibility of distortion. When used with a high-quality cone speaker, the receiver will faithfully reproduce all the essential frequencies of a symphony orchestra, from the highest flute to the lowest drum.

Because of the variation of reception conditions from point to point, it means very little to say that at Ithaca, New York, it is possible to bring in with good volume stations in the four corners of the United States, and in Mexico and many parts of Canada. It is always possible to get down to the noise level with this receiver; and actual comparison shows it to have an amplification at least the equal of any seven-tube shielded radio-frequency receiver or any ordinary eight-tube superheterodyne (excepting, of course, receivers using the new screen-grid tube). Practically any night, and sometimes even during the day, it is possible to get ten or fifteen outside stations with ample volume when the second radio-frequency tube is removed from the set. (Energy is then carried through the dead stage by way of the neutralizing condenser.)

The selectivity of the superheterodyne receiver is well-known, and needs little further discussion. No difficulty is experienced at Ithaca in separating any two stations that do not actually heterodyne each other. Careful testing indicates, however, that tuning is sufficiently broad to pass the requisite band of frequencies, and discloses absolutely no evidence of the cutting of sidebands. This is to be expected, since the intermediate amplifier is really a shielded radio-frequency receiver, each stage of which tunes fairly broad. In a direct comparison with a shielded radio-frequency receiver, using the same audio amplifier and loud speaker, no difference in tone quality could be observed.

The fact that there are only two tuning condensers, and that the oscillator has only one setting for each station, makes tuning extremely simple.

The hook-up, as shown in Fig. 3, differs from that of the ordinary superheterodyne only in the addition of neutralization and shielding and in that the tuning of the intermediate-amplifier stages is adjustable. The intermediate frequency is kept at the chosen value of 461-kc. by means of the second-detector circuit, which has a fixed .0005-mf. tuning condenser; and the intermediate stages are tuned to match this. The output plate choke of the power stage and the choke in the "B+" lead of the first detector are mounted on the power unit in order to keep the size of the receiver as small as possible. Also, a second-detector choke is necessary to prevent the audio-frequency component of the first detector output from feeding directly to the audio amplifier via the common "B+" lead.

Volume is controlled by a 20-ohm rheo-

List Price $6.50

Write for Full Details of the new CeCo R. F. 22

THE "Ceco" RF-22 is of the four-element shielded grid type, and can be used to advantage only in special circuits or equipment designed for its use. Its high amplification, constant and practically negligible control grid to plate capacity make this type of tube very efficient when used properly. The RF-22 is primarily designed to be used as a radio frequency amplifier and as such is capable of a voltage amplification of from 30 to 60 per stage, dependent upon circuit design. It may also be used as an audio frequency amplifier where resistance coupling is employed. One of the several uses of the RF-22 is that of a "Space Charge Grid" tube.

CeCo RADIO TUBES

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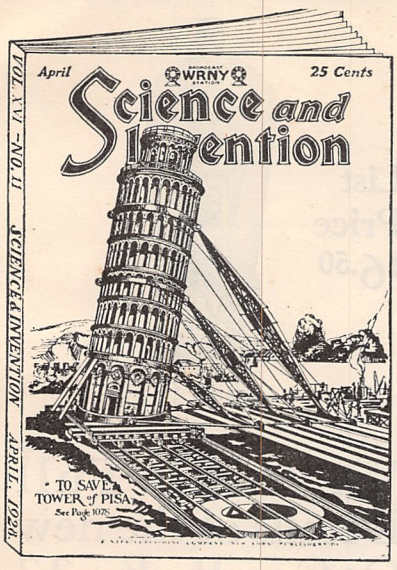

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Experimenter Publishing Co.

230 FIFTH AVENUE

NEW YORK, N. Y.

stat in the filament circuit of the first intermediate-frequency tube. This method makes possible the variation of volume from zero to a maximum without distortion. The jack which is mounted on the panel provides for the insertion of an external 20-ohm rheostat in place of that on the panel; so that volume may be controlled from a point away from the set. Since one side of the rheostat connects to ground, through "A—," it is necessary only to run one wire from the tip of the plug in order to vary the volume from another point in the house. The water or heating pipes serve as the other line.

A second jack is provided for connecting an electrical reproducer to the audio amplifier, and automatically cuts off the filaments of all but the audio-amplifier tubes. The first detector, as well as the intermediate-frequency stages, must be neutralized; since the primary of the first intermediate-frequency transformer is in the plate circuit of the first detector, and therefore tends to produce regeneration unless the neutralizing winding is used.

(To be continued)

Compensating Line-Voltage Variations in an Electric Set's Power Supply

REPORTS received from the owners of receivers employing A.C. tubes of the new 226 and 227 types vary widely as to the results obtained. In most cases the tubes have given entirely satisfactory service, and the reproduction obtained from the receiver is all that could be desired. On the other hand, there have been received some complaints that the life of the new tubes is rather short, with the result that the cost of replacement has been rather heavy.

Due to the experience of a few experimenters who have found that their tubes burn out at too-frequent intervals, the rumor seems to be quite prevalent, that a large number of the new A.C. tubes are defective. However, this is not necessarily true, while investigation seems to indicate that it is false. It has been discovered that, in practically all cases where short tube-life is experienced, the trouble is due to the application of excessive voltage overloads to the tube filaments; resulting from a high line-voltage at the house lighting source, without suitable means of regulation in the power unit of the receiver.

In operation, A.C. tubes are no more critical as to filament voltage than standard tubes of the 201A type; but trouble is caused by the fact that the house-lighting circuit sometimes does not provide as constant a source of potential as does a storage battery. In the case of the latter, the maximum voltage in the filament circuit is known to be 6 volts, and it is possible to insert ballast resistors in the circuit and reduce the potential to the value required by the tubes. In this way it is possible to operate a receiver without any danger of overloading the filaments. In contrast to this, there is no definite maximum voltage of an A.C. house-lighting circuit. These circuits are usually rated at 110 volts but, during the day, the voltage may vary all the way from 90 to 125 volts in extreme cases; and for this reason some form of voltage regulator is needed in every radio power unit. Voltage variations are not as great in the large cities as in the rural districts where elaborate regulating devices are not provided; but in all cases it is wise to use some type of voltage control.

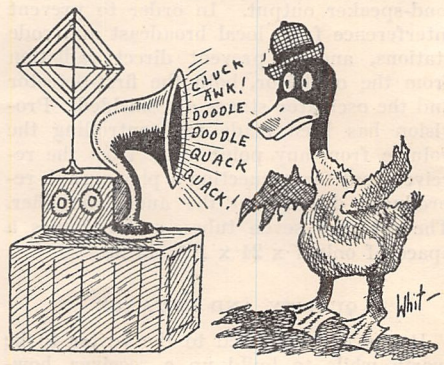
TESTING LINE VOLTAGE

A satisfactory solution to the problem is found in connecting a power-rheostat in series with the primary (110-volt) winding of the filament-supply transformer, and with this instrument the filament potentials of all tubes may be adjusted simultaneously. After the construction of the receiver has been completed, the resistors in series with tube filaments should be adjusted and checked with an A.C. voltmeter until each tube receives exactly the correct voltage. When a set has been adjusted in this way an adjustment of the master rheostat in the primary winding of the transformer will bring all filament circuits back to the correct voltages, whenever the line voltage increases or decreases, as the case may be.

When operating a receiver with a master rheostat connected as described, a wise habit for the owner to cultivate will be the practice of setting the rheostat so that the filament-current adjustment is at a *minimum*, every time when he is turning off the set. If this plan is followed, the danger of overloading the filament will be greatly reduced; but it becomes necessary to increase the voltage to the proper value each time the set is used. On the other hand, if the set were not adjusted each time, there would be little advantage in having a master rheostat. It may also be suggested that a 150-volt A.C. voltmeter will be a great aid when adjusting the master rheostat; as it will remove the guesswork which is usually involved in the regulation of filament current. The increase in the life of the tubes used would probably pay the cost of the meter in a very short time.

In rural districts where the power supply is known to be very irregular, it will be wise for the radio listener to investigate conditions before deciding to use an A.C. set. In some places there are continual line-voltage fluctuations which would make it very unsatisfactory to attempt the operation of an electric radio receiver.

A RADIO QUACK



"I don't know what he's saying; but it sounds like fowl language to me!"—MAX WHITSON.

Quartz Crystals Control Television Apparatus

(*Continued from page* 1231)

age to alternate rapidly, we cause very slight twistings and untwistings of the crystal, and these are most effective at *a certain frequency, depending on the size of the crystal.* This adjustment is very critical, and renders possible a remarkable degree of accuracy in the regulation of oscillating radio circuits.

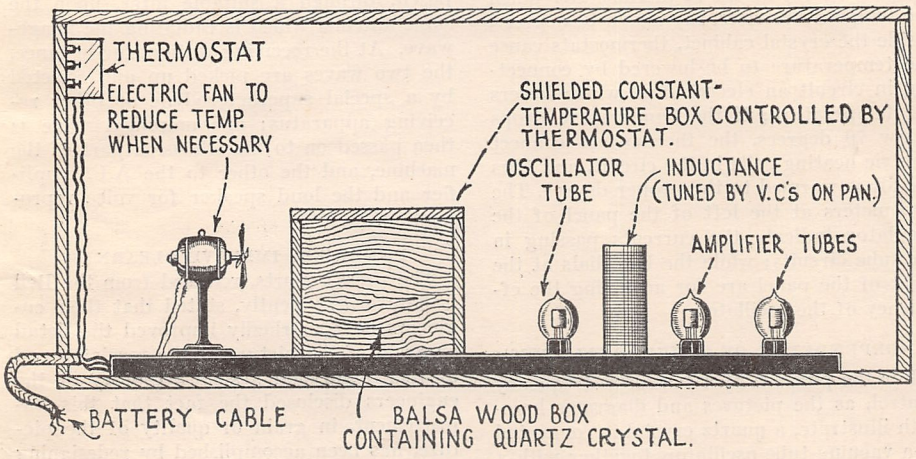
THE INVISIBLE PENDULUM

Just as a clock's pendulum has a fundamental frequency depending on its length, so has the crystal a fundamental frequency which depends on its size. A pendulum governs a clock by allowing the wheels to move only between intervals regulated by its natural period of swing. But in order to have a clock regulated at intervals of one one-millionth of a second, it would be necessary to have a gravitational pendulum *only one twenty-five-billionth of an inch long.* A pendulum of this frequency is provided by the molecules of a quartz crystal cut to a frequency of 1,000 kilocycles, under the influence of a suitably-adjusted circuit.

Such a crystal oscillator was recently built by the Bureau of Standards, taken to Europe, and compared with standard oscillators in England, France, Germany, and Italy. It was found that the accuracy of regulation obtained by the crystal is within a variation of but thirty cycles in the million; or, if it governed a clock with a million ticks a second, it would vary not more than a minute and nineteen seconds a month!

The crystal of quartz occurs, in nature, in the shape of a six-sided prism, with two pointed ends; something like the glass pendants which are often hung from chandeliers. In order to make it suitable as a "piezo-electric" governor of the frequency of electrical apparatus, it has to be cut down; the more it is reduced in size, the lower the wavelength corresponding to its fundamental frequency. The preparation of a crystal for use in this manner is shown in one illustration, and the cut-and-tested crystal, mounted for use in its oscillator, in another. The crystals are carefully ground to size on special grinding wheels, and are checked in the laboratory before being mounted.

A second important thing is that the frequency which the crystal will pass is con-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SHIELDED CONSTANT-TEMPERATURE BOX CONTROLLED BY THERMOSTAT.
OSCILLATOR TUBE
INDUCTANCE (TUNED BY V.C's ON PAN.)
AMPLIFIER TUBES
BATTERY CABLE
BALSA WOOD BOX CONTAINING QUARTZ CRYSTAL.

Fig. 6—Elaborate precautions are taken to keep the crystal at an even temperature, by a double system of thermostatic control. The apparatus inside the balsa-wood box is shown on page 1283.

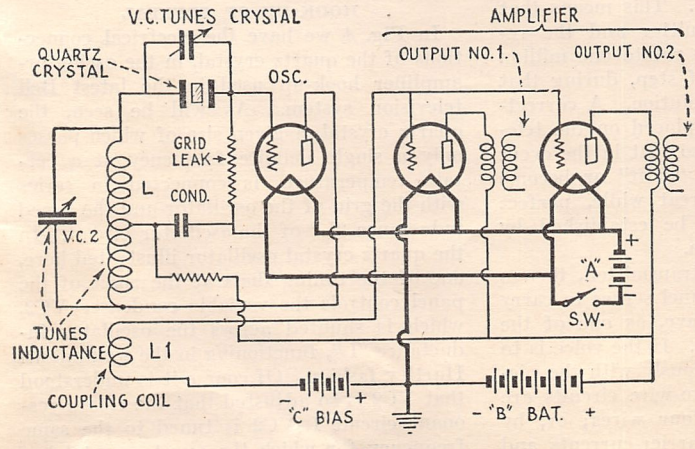

FIG.4

The schematic hook-up of the crystal-controlled oscillator circuit and the amplifier which it regulates; the condenser, VC, permits very slight changes in the adjustment of the oscillator's frequency. VC2 tunes the principal inductor of the Hartley circuit, which is coupled to the amplifier-tube grids through the pick-up, L1. The output is a true alternating current of very constant frequency.

New AERO Circuits For Either Battery or A. C. Operation

Proper constants for A. C. operation of the improved Aero-Dyne 6 and the Aero Seven have been studied out, and these excellent circuits are now adaptable to either A. C. or battery operation. A. C. blueprints are packed in foundation units. They may also be obtained by sending 25c for each direct to the factory.

AERO Universal Tuned Radio Frequency Kit

Especially designed for the Improved Aero-Dyne 6. Kit consists of 4 twice-matched units. Adaptable to 201-A, 199, 112, and the new 240 and A. C. tubes. Tuning range below 200 to above 550 meters.

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Code No. U-123 (for .00035 Cond.)..... **12.00**

NOTE—All AERO Universal Kits for use in tuned radio frequency circuits have packed in each coil with a fixed primary a twice matched calibration slip showing reading of each fixed primary AERO Universal Coil at 250 and 500 meters; all having an accurate and similar calibration. Be sure to keep these slips. They're valuable if you decide to add another R. F. Stage to your set.

A NEW SERVICE

We have arranged to furnish the home set builder with complete Foundation Units for the above named Circuits, drilled and engraved on Westinghouse Micarta. Detailed blueprints for both battery and A. C. operation and wiring diagram for each circuit included with every foundation unit free. Write for information and prices.

You should be able to get any of the above Aero Coils and parts from your dealer. If he should be out of stock order direct from the factory.

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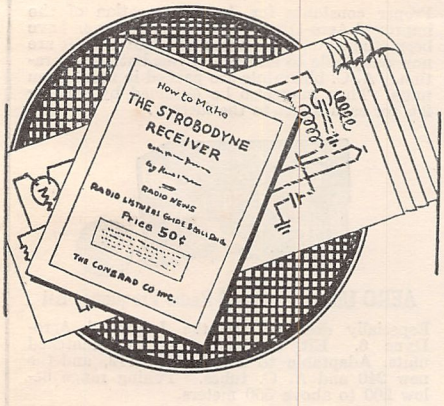

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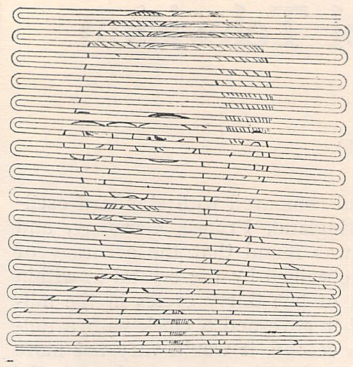
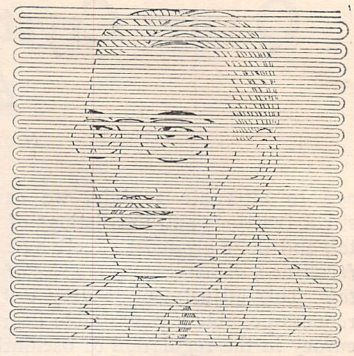


The new screen (Fig. 3, right) contains twice as many distinct luminous points as the old one (Fig. 2, left); and therefore brings out every feature twice as sharply. The neon tube covers an area 24 x 36 inches, with the largest television image yet produced.



trolled by temperature changes. Therefore, as may be seen from the accompanying view of the quartz-crystal-oscillator set-up, the crystal is mounted in a wooden box, in which the air is maintained at a constant temperature by means of thermostats. When the temperature rises, say above 70 degrees, inside the crystal cabinet, thermostats cause the temperature to be lowered by connecting in circuit an electric fan, which lowers the temperature; if the temperature drops below 70 degrees, the thermostats connect electric heating coils in the circuit, and thus the air is warmed to the proper degree. The two meters at the left of the panel of the oscillator indicate the currents passing in the tube circuits; while the two dials at the right of the panel are for adjusting the efficiency of the oscillator.

INDEPENDENCE OF SYNCHRONIZATION

For the purpose of a television-frequency control, as the pictures and diagrams herewith illustrate, a quartz crystal is connected to a vacuum-tube oscillator, together with a suitable vacuum-tube amplifier; the "sine-wave" alternating-current output of this set-up is fed into a high-frequency synchronous motor, mounted on the disc-driving shaft beside a 60-cycle synchronous motor. As the reader will probably recollect, in the Bell television system each disc-driving shaft carries a 60-cycle synchronous 110-volt A.C. motor; and also a special high-frequency A.C. motor; the high-frequency motor is used to improve the synchronism or constancy of revolution of the disc, because a slight slippage or variation in the speed of the high-frequency motor will not be so noticeable as a corresponding variation in the case of a low-frequency motor. Between the two motors a very accurate constancy of rotation is maintained.

In fact, the writer is informed by the engineers who have perfected the quartz crystal for use with the television apparatus, that the accuracy of the speed as related to perfect synchronism has reached *the order of one part in a million.* This means that the discs of the transmitter and the receiver, respectively, may rotate one million times and not be out of step, during that time, more than one revolution. A correcting button, however, is placed on the television machine cabinet, so that in the event that the picture should "drift" or become distorted, once in a great while, perfect synchronism can again be established by simply pressing a button.

If no voice is to be transmitted, then a single wire or radio channel serves to carry the image-current or wave, as one of the diagrams herewith shows. If the voice is to be transmitted simultaneously with the picture image, then two two-wire circuits are to be used, requiring four wires; or, by utilizing two different carrier-currents and super-imposing these on one two-wire metallic circuit, both the image- and the voice-currents can be carried to the receiver; or thirdly, if radio transmission between the transmitter and the receiver is to be utilized, the voice current may be super-imposed, through a suitable filter, upon the same antenna which is radiating the image-wave. At the receiving station, for instance, the two waves are picked up and selected by a special superheterodyne or other receiving apparatus; one amplified wave is then passed on to the television part of the machine, and the other to the A.F. amplifier and the loud speaker for voice reproduction.

ENGINEERS IMPROVE CLEARNESS

The press reports, released from the Bell Laboratories recently, stated that their engineers have markedly improved the detail or grain of the picture at the receiving end of their television system. Inquiry of the engineers disclosed the fact that this improvement, in grain or quality of the picture, has been accomplished by redesigning the large exhibition screen, measuring 24 by 36 inches. This refinement in the screen detail or fineness of the picture, and therefore its quality, is brought about by incorporating more convolutions in the neon tube forming the "grid," on which the image is reproduced; and also by mounting a greater number of tinfoil segments along each leg of the sinuous glass grid tube. In the old exhibition-size television screen, there were 50 convolutions of the neon-gas-filled tube and, along each limb of this glass tube, there were 50 tinfoil segments. Thus, there were 2,500 tinfoil segments, in all, on the old screen; the new screen contains 72 convolutions of the neon tube, and along each limb there are 72 tinfoil segments. The total of tinfoil segments, therefore, is 5,184, or a little more than twice the number on the old screen. This gives us, therefore, twice the detail and quality in the reproduced image as compared to that projected on the old screen.

HOOK-UP OF CRYSTAL

In Fig. 4 we have the electrical connections of the quartz crystal, in the oscillator-amplifier hook-up used in the latest Bell television system. As will be seen, the quartz crystal, a given size of which passes only a single definite frequency at a certain temperature, is connected in series with the grid of the oscillator and the tuned inductance "L" of the oscillator circuit. In the quartz-crystal oscillator illustrated here, one of the tuning dials at the right of the panel controls the variable condenser VC2, which is shunted across the oscillator inductance "L", functioning in the well-known Hartley fashion. Of course it is understood that VC2 is so adjusted that the closed resonant circuit L-VC2 is tuned to the same frequency for which the quartz crystal has been ground. Whenever the condenser

VC2 is changed, in order to tune this circuit to a frequency in a different band, another quartz crystal, calibrated for the approximate value of the new frequency or wavelength, is placed in the temperature-controlled receptacle housing the crystal.

The second variable-condenser dial, appearing at the right of the panel, is used for the purpose of tuning the quartz crystal; and certain "plus" or "minus" corrections or adjustments in the frequency to which the crystal responds are thus made by means of this dial. In other words, the quartz crystal is ground and "lapped" in the laboratory until it is brought to the proper size, corresponding to the desired frequency. But, if it does not respond naturally to that exact frequency, it may be made to do so by carefully adjusting the variable condenser dial VC.

As the diagram shows, the output of the amplifier may be taken from either the first or the second stage. A "C" bias is placed on the grids of both amplifier tubes, as indicated; and the grid circuits of these tubes are coupled to the Hartley-oscillator inductance "L", by the coil L1.

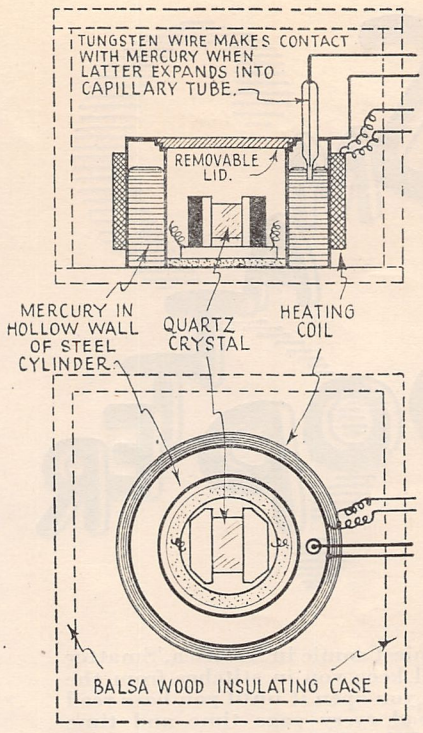
The output of either of the amplifier stages of the oscillator set-up, is in the form of a *"sinusoidal"* or alternating current, the frequency of which is maintained to an astonishingly high degree of accuracy. One of the problems met, in maintaining constant the frequency with such a quartz-controlled oscillator, lies in providing a very stable and constant grid-leak resistor; for this particular circuit there has been developed a resistor of new type which will not vary as much as 0.1 per cent. Fluctuations or variations in the battery voltage are an important source of trouble; but these voltages are now maintained sufficiently constant, with a plus or minus variation of about 2 per cent. The variation in the oscillator's frequency from this cause is only about three parts in 10,000,000. It is also possible to compensate the circuit; so that variations in voltage will result in offsetting a change in frequency in one direction by setting up an equal and opposite reaction.

REGULATING THE HEAT

Referring to the detailed illustration of the quartz crystal and its mounting, the crystal vibrates along the longitudinal axis, or line of its greatest length. It is separated from the metal plates by silk threads, which also support it. Within the balsa-wood box which houses the crystal, the temperature must be kept the same at all times, within 1/20th of a degree (F.), in order to reduce frequency variations due to the heat of the crystal (and its consequent changes in size) to *one part in ten million.*

(The frequency of the crystal is affected also, slightly, by changes in atmospheric pressure; as explained in a paper presented to the Union of Scientific Radio Telegraphy at Washington, Oct. 13, 1927, by J. W. Horton and W. A. Morrison.)

The quartz crystal in its mounting (as shown in the picture) is placed within a steel cylinder which (see Fig. 5) has hollow walls within which mercury is placed. Whenever the temperature rises it causes the mercury to expand into a "capillary" (very fine-bore) tube which contains an electrical contact of tungsten wire. At the predetermined point, the mercury reaches the tungsten wire and operates a relay, opening the circuit through a heating coil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REMOVABLE LID.
MERCURY IN HOLLOW WALL OF STEEL CYLINDER
QUARTZ CRYSTAL
HEATING COIL
BALSA WOOD INSULATING CASE

FIG. 5

The quartz crystal is kept inside a jacket of mercury; the slightest change in the temperature of which makes or breaks the electrical circuit of the heating coil, and thus keeps the temperature even.

wound around the outside of the steel cylinder. When the temperature falls sufficiently, the heating circuit is again closed. By this means the temperature in the cylinder is kept very uniform.

The cylinder with the mercury-filled wall has lids at top and bottom; and this miniature "safe" with its crystal, which may be indeed called a precious stone (it is "rock crystal," the same mineral of which many of the "diamonds" you see in cheap jewelry are composed; but the value is in its careful cutting and adjustment) is placed in a balsa-wood box for protection against external changes of temperature. The box is visible, in the panel view of the oscillator apparatus, as the square object above the panel in the center of the apparatus. (See also Fig. 6.) The entire assembly, with the oscillator-panel, inductance, amplifying tubes, ventilating fan, etc., is in turn placed within a larger closed cabinet; the air in which is regulated to a constant temperature by a thermostatic apparatus.

From Fig. 4 it will be seen that a resistor is connected in series with the "B" plate supply to the oscillator tube, to keep the plate voltage on this tube at a low value. This is for the reason that some energy is dissipated within the crystal; and the energy dissipated varies approximately as the square of the plate voltage. This phenomenon is important with regard to the system maintaining constant the temperature of the crystal when in operation; for it will now be seen why the temperature of the crystal is not exactly that of the air surrounding it.

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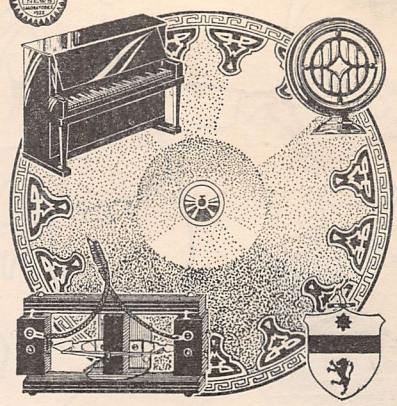

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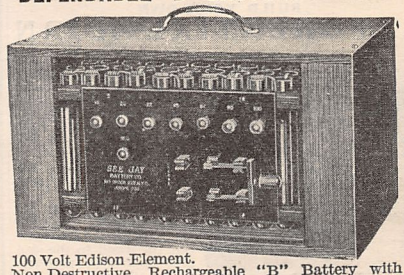

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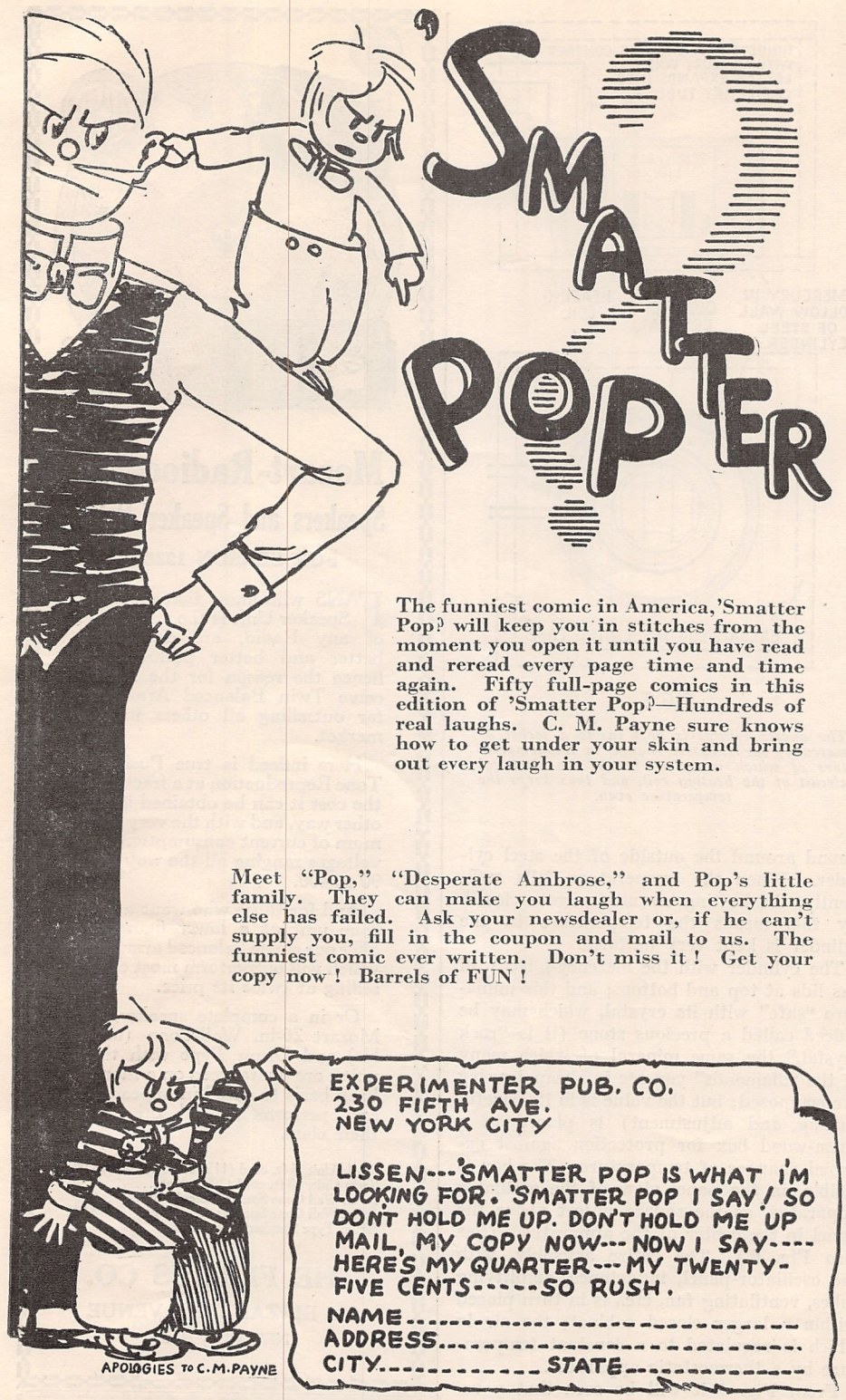

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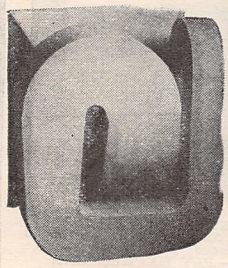

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A Simple "Extension" Two-Tube Receiver

(*Continued from page* 1229)

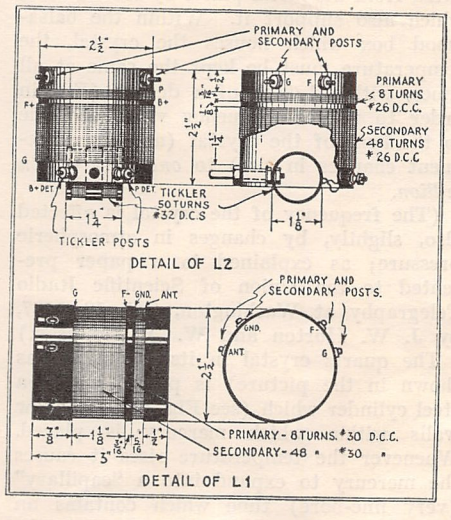
that is, each wire is connected directly from one instrument to the next without regard to appearance. This makes possible the use of the least amount of wire, and, as a result, prevents many electrical complications. All connections should be properly soldered and, if tinned wire is used, this is very easily accomplished, even by a novice at soldering.

COST OF PARTS

Even when the best parts are used the cost of this set is very low. The beginner is warned, at the start, not to try to save money by selecting second-class apparatus. If it is found that the total cost of the parts exceeds the amount allowed by the family budget, it will be better to save money on the decorative items, such as the dials and the cabinet, rather than on the electrical parts. Inferior parts are incapable of giving the results which may be obtained from apparatus of good quality; almost always it will be found that they are inefficient electrically or their mechanical construction is poor, and, in either case, the result is highly undesirable.

In the construction of the set there are only two semi-expensive parts required (the two variable condensers) and these should not cost over five dollars each. The coils may be home-made, if it is so desired; or factory-built units may be purchased. The remaining parts are few in number and very inexpensive.

Before explaining the construction of the set the operating features will be considered. Of course, unless the builder wishes to build or buy a power unit, batteries are required. For the filament or "A" current supply, either dry cells or a storage battery may be used. If 201A-type tubes are used in the sockets of the set, a 6-volt storage battery is needed; but, if 199-type tubes are employed, the set may be operated with three No. 6 dry-cell batteries connected *in series.* The set may be used with tubes of either type, provided the proper filament-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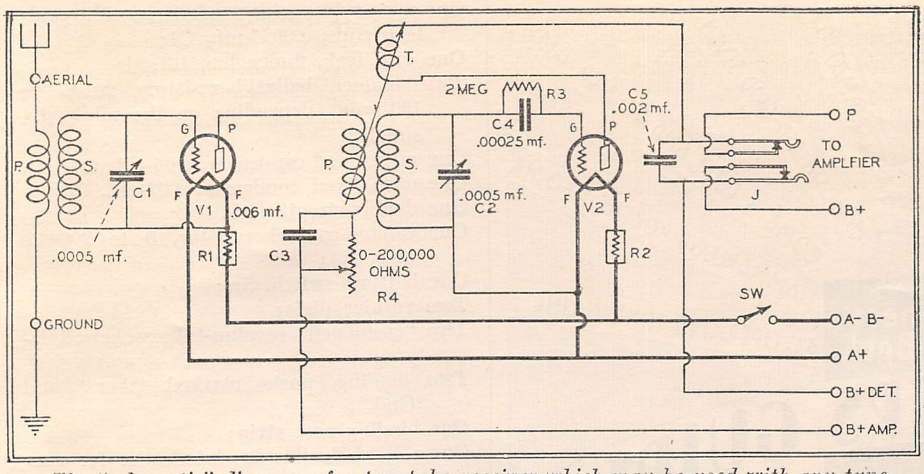
TICKLER 50 TURNS #32 D.C.S
TICKLER POSTS
DETAIL OF L2
PRIMARY AND SECONDARY POSTS.
PRIMARY - 8 TURNS. #30 D.C.C.
SECONDARY - 48 " #30 "
DETAIL OF L1

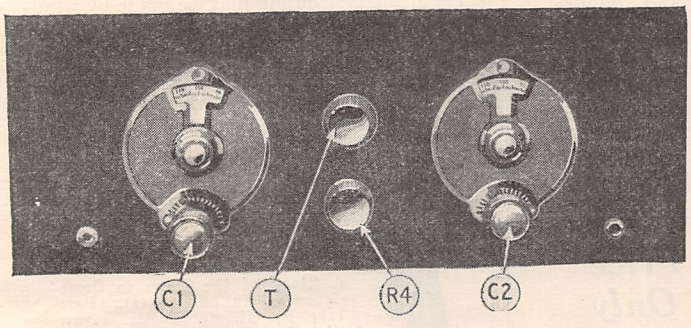
Constructional details of the antenna coupler, L1, and the detector-circuit tuner, L2.



The "schematic" diagram of a two-tube receiver which may be used with any type of A.F. amplifier. Headphones also may be plugged into the jack, J.

ballast units are used at R1 and R2 in the circuit (see above). For the plate voltage of the set, 90 volts of "B" batteries are required. As the set uses only two tubes it is not absolutely necessary to buy the heavy-duty batteries; but a large battery will be found more economical than the smaller size which is intended primarily for use in portable receivers. In addition to the batteries, the only accessories required for the operation of the receiver are a pair of headphones and plug, an aerial with its lead-in, a ground connection and a lightning arrestor.

The actual operation of the receiver will be found very simple as there are only two dials and two knobs which will ever require adjustment. The two dials (C1 and C2) are the *"wavelength controls"* of the receiver, and both of these dials are set in approximately the same position when the set is correctly tuned to any station in the broadcast waveband. The knob marked T is the "regeneration control," and the knob marked R4 the "volume control." Neither T nor R4 is at all critical when tuning in stations. In the lower left corner of the panel the battery switch (Sw) is located; and in the corresponding position at the right the jack for the headphones is located. Also, if the set is to be used in connection with an audio amplifier, this jack makes it possible to plug in on the detector circuit with headphones at any time.

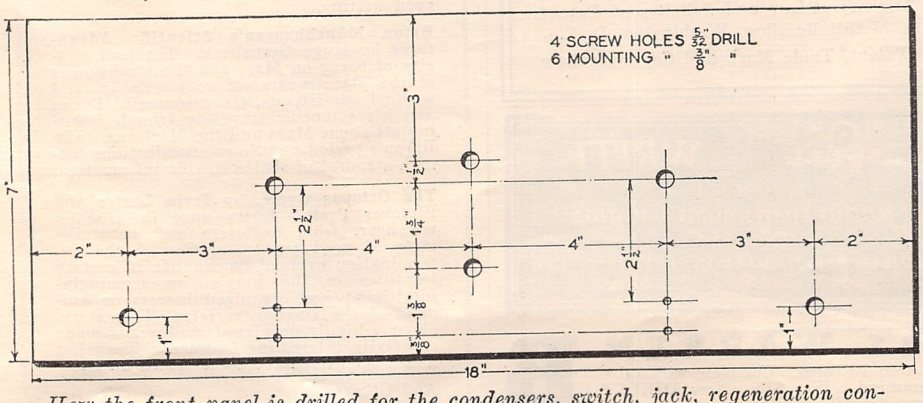


The front view of the Beginner's two-tube tuned-radio-frequency receiver. C1 and C2, condenser controls; T, tickler control; and R4, volume control.

LIST OF PARTS

A complete list of the component parts necessary for building this receiver, with their designations in the diagrams and pictures, is as follows:

One front panel, of bakelite or hard rubber, 18 x 7 x 3/16-inches;
One baseboard, of wood, 16 x 7 x ½-inch;
One "antenna coupler," L1 (For details see text and diagrams);
One "detector-circuit tuner," L2 (For details see text and diagrams);
Two variable condensers, .0005-mf., C1 and C2;
Two vacuum tubes, 201A- or 199-type, V1 and V2;



How the front panel is drilled for the condensers, switch, jack, regeneration control, and variable resistor in the two-tube receiver.

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Two "filament-ballast" resistors, 201A- or 199-type (depending on the tube), R1 and R2;
One mica fixed condenser, .006-mf., C3;
One mica fixed condenser, .002-mf., C5;
One double-circuit jack, J;
One volume-control resistor, 0 to 200,000 ohms, R4;
One battery switch, Sw;
Two vernier dials;
Two "cushioned" vacuum-tube sockets, UX-type;
Two binding posts marked "Aer." and "Gnd.";
One binding-post strip;
One roll of flexible insulated wire for connections;
One table-type cabinet.

Before buying the parts listed above it is necessary to decide whether you wish to build or buy the two coils required. If you decide to wind the coils at home the cost of the set may be materially decreased; as suitable wire and coil forms may be purchased at much less than the cost of a manufactured set of coils. Also, the construction of the coils is very simple.

The antenna coupler is the simplest coil to make. It is wound on a composition or cardboard tube 2½ inches in diameter and 2½ inches long. There are two windings, the primary (P) and the secondary (S). The primary winding may be made by winding 8 turns of No. 30 D. C. C. wire about ½-inch from one end of the tube. After the primary winding has been completed, a space of about 3/16-inch is left vacant, and then the secondary coil is wound. The

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And Others.

secondary consists of 48 turns of No. 30 D. C. C. wire wound in the same direction as the primary. After the coil has been wound, it should be painted with collodion or some insulating varnish and it is complete.

In constructing the detector-circuit tuner, a coil wound with No. 26 D.C.C. wire is made, exactly the same as the antenna coupler; and to this is then added the tickler coil (T). The tickler coil should be wound on a tube 1⅛ inches in diameter with 50 turns of No. 32 D. C. C. wire. This coil is mounted on a shaft and is so arranged that it may be rotated by a knob located on the front panel of the receiver. The diagram, which will be found in these pages, shows the mechanical arrangement which should be followed.

CONSTRUCTIONAL HINTS

After all of the parts have been purchased, they should be carefully tested and inspected for mechanical defects. For example, make sure that the plates of the variable condensers do not short-circuit (touch) when they are rotated; and see hat the tube makes good contact to the prongs of the socket. In the case of the dials see that there is no appreciable "backlash" and that they do not tend to slip. See that the contact arm of the volume-control resistor makes a good mechanical connection with the wire when it is rotated. Make sure that the phone plug makes good contact with the jack and see that, when the plug is removed, the contacts of the jack are fully closed.

In constructing the receiver, the first step is to drill the necessary holes in the front panel. Accompanying this article will be found a drilling layout for the panel; which will be correct if the parts used in the original model are employed. However, if different parts are employed, it may be necessary to make slight departures from the layout. If different condensers are used, a "template" which usually is supplied with them indicates the exact position of the mounting holes required.

In mounting the parts on the front panel, the detector-circuit tuner is located in the center with the tickler-coil shaft toward the top of the panel. Below the regeneration knob is the volume-control resistor; and one tuning condenser is mounted on each side of the circuit tuner, midway between the center of the panel and the edge. The jack is located in the lower right corner of the panel, and the battery switch is in the corresponding position at the left.

After this, the remaining apparatus should be mounted on the baseboard of the receiver. When looking at the receiver from the front, the apparatus on the baseboard is arranged as follows: the antenna coupler is located directly behind the tuning condenser C1, near the left edge of the baseboard toward the rear. Just behind the antenna coupler, the binding-post strip for the aerial and ground terminals is mounted.

The vacuum-tube socket for V1 is mounted at the right of the antenna coupler, and that for V2 near the right edge of the baseboard toward the rear. The two filament ballast resistors (R1 and R2) are located between the two sockets. The grid condenser with its grid leak (C4 and R3) is fastened directly to the *stator* terminal of condenser C2. Condenser C5 is fastened in place, with its wiring near the jack; and condenser C3 is also fastened in place, with the wiring near the volume-control resistor.

After the parts have been mounted the receiver may be wired. The pictorial and schematic wiring diagrams, which will be found in these pages, clearly show every necessary connection and as a result very little explanation is necessary. When wiring the plate and grid circuits, care should be taken to see that the wires which connect to the "P" and "G" terminals of the tube sockets are as short as possible, and that they do not come near other parts or wiring. The battery wires may be bunched together if desired. Every connection should be soldered, and care should be taken to see that the joint is strong and that the solder makes a good connection with both wires. In soldering with rosin-core solder, scrape the parts to be soldered until they are clean, and use tinned wire; and then no difficulty will be experienced.

From the pictorial wiring diagram it may be seen that the battery wires of the set are not connected to binding posts; but the connecting wires are soldered to the terminals of the various instruments and led out from the rear of the set in cable form. Label or tag the wires at both ends before cabling. This is the most convenient method; as the wires of the cable may be connected directly to the batteries.

OPERATING THE RECEIVER

After the construction of the receiver has been completed the set should be carefully tested before it is placed in operation. First, place the two tubes in their sockets, turn on the filament switch, and connect the negative terminal (the black one) of the "A" battery with the wire of the cable marked "A— B—." Now connect a wire to the free terminal (the positive one) of the "A" battery; and touch this wire in turn to each wire in the battery cable. The tubes should light when the "A+" wire of the battery is connected to the "A+" wire of the cable; but they *should not light* when the "A+" wire is touched to the "B+ Det." and "B+ Amp." wires. If the tubes do light when the "A+" wire of the battery is connected to the "B+" wires of the battery cable, there is a short-circuit in the set *which must be discovered and corrected before the set is placed in operation.*

On the other hand, if the test proves that the set is correctly connected, the "A" and "B" batteries may be connected with the proper battery-cable leads; the aerial and ground wires attached to their respective binding posts; and the phone plug with the phone cords attached, inserted in the jack. The set is then ready for operation and may be turned on with the battery switch.

The aerial should consist of a wire about 100 feet long, including the lead-in, strung as high as possible, firmly secured to well-braced supports at each end, and carefully insulated. The wire should be led into the house through a porcelain insulating tube, or similar device. An approved lightning arrestor is a desirable attachment; this should preferably be grounded outside the house. The ground wire from the set should be made to a cold-water pipe if possible, or else to a steam pipe; the pipe should be scraped until it shows a bright metallic surface, and the wire wrapped around it tightly—securely soldered if possible—and the joint wrapped with friction tape to protect it. Upon the electrical contact obtained at this connection will depend a great deal of the results obtained with this receiver.

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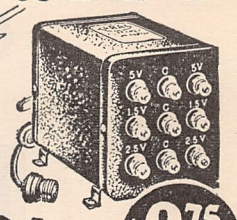

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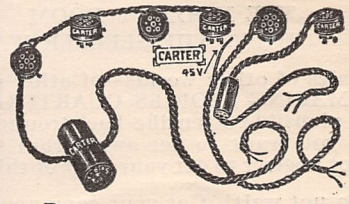

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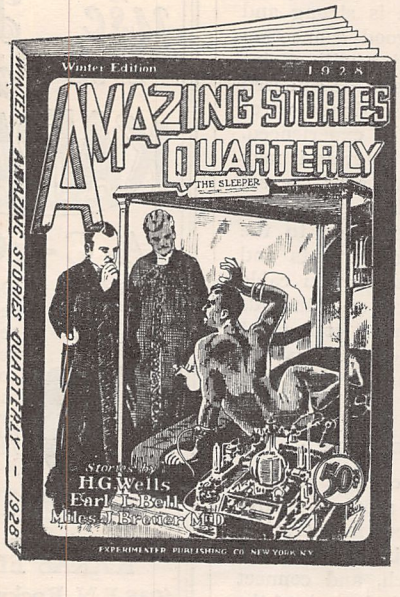

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Regeneration—What It Is and What It Does

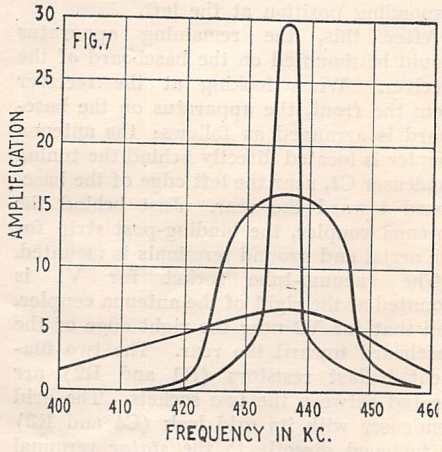
(*Continued from page* 1235)

cation, which prevents radiation from the antenna. The essential piece of apparatus is the three-coil coupler (L1). This consists of a primary coil (P) of a few turns which is connected directly in the antenna circuit or preceding R.F. circuit, a secondary coil (S) tuned to the desired wavelength by a variable condenser (C), and a tickler coil (T). The primary and secondary coils are usually wound on the same tube form and are coupled "tightly." The tickler coil is wound on a separate tube, and the coupling between the secondary and the tickler is adjustable by rotating the tickler on its shaft. As may be seen from the diagram (Fig. 1) the secondary is connected in the grid circuit of the receiver and the tickler is connected in the plate circuit. By adjusting the coupling of the tickler the feed-back or regeneration may be increased. The construction of such a "tuner" is shown in "The Radio Beginner" on page 1284 of this issue.

MODES OF REGENERATION

In the circuit described, the method of obtaining regeneration is called *inductive feed-back* because the energy from the plate circuit is returned to the grid circuit *inductively; i.e.,* by virtue of the close proximity of the tickler coil to the grid coil. In the operation of this receiver signals are to be tuned in by adjusting the condenser C, as this governs the wavelength of the grid circuit; then, after the signal has been tuned in, its strength may be brought up by carefully increasing the coupling between the tickler coil and the secondary coil—that is, turning the tickler tube until it comes more nearly straight with the tube of the secondary.

Another popular regenerative receiving circuit will be found in Fig. 2. This type of receiver is known, properly, as the "three-circuit tuner," and in the early days of broadcasting it was almost as popular as the tickler-feed-back system just described. In this receiver feed-back is obtained through the grid-plate capacity of the tube, and this feed-back takes place when the plate circuit is tuned to approxi-



This graph clearly shows that as regeneration increases the sensitivity (height of the curve) and selectivity (sharpness of the curve) are also increased.

mately the same wavelength as the grid circuit.

From the diagram it will be seen that energy from the antenna circuit is transferred to the grid circuit in exactly the same way as in Fig. 1; that is, the primary coil (P) of the antenna coupler (L1) is connected between the aerial and ground, and the secondary coil (S) is connected between the grid and the filament of the tube. As there is an *inductive* relation between these coils, energy is transferred; and the condenser (C), which is connected in shunt with the secondary coil, tunes the circuit to the desired wavelength.

The *"variometer"* (L2) connected in the plate circuit of the tube is the interesting feature of the circuit. This unit is a *continuously-variable inductance* and it is equivalent to a coil of wire shunted by a variable condenser.

In operating this receiver the grid circuit was tuned to the wavelength of the desired station, and the variometer employed to control regeneration. As the wavelength of the variometer was adjusted to approach the wavelength of the grid circuit, the regeneration increased. This is because the alternations in the plate circuit were forced to return to the grid circuit through the small *capacity* (condenser) formed by the close proximity of the grid and plate elements of the tube. Of course, in this circuit regeneration would produce an effect upon the signal identical with that obtained by using the circuit in Fig. 1. Also, regeneration would cease and the tube breaks into oscillations when the feedback passed a certain critical value.

Regenerative circuits using a variometer in the plate circuit of the detector tube are called *tuned-plate* or *capacity-feed-back* receivers. In addition, it may be pointed out that the regeneration which is found in the average tuned R.F. receiver is usually produced by this method.

THE REINARTZ CIRCUIT

There are three basic ways in which regeneration may be produced in a radio receiver; the first two are illustrated in Figs. 1 and 2, and the third in Figure 3. The last is popularly known as the Reinartz circuit, as it was first introduced for the reception of short-wave "C.W." signals by the well-known amateur experimenter, John L. Reinartz. This circuit, which employs a combination of inductive and capacitive feed-back methods, has been found excellent for the reception of continuous-wave (code) signals but is not as satisfactory for the reception of phone signals as the two circuits previously described. It is only one of a number of different circuits which use this system of regeneration, but is probably the best known of its type.

In this circuit the grid and antenna circuits are arranged in much the same way as in Figs. 1 and 2; the chief difference being that the primary coil (P) and the secondary coil (S) of the coupler (L1) are coupled together conductively as well as inductively. However, the plate circuit is very different. First, it will be noticed that there is an R.F. choke coil connected between the plate of the tube and the phones. This prevents the R.F. current from being short-circuited through the phones to the filament. Next, it may be seen that there is a wire which connects the plate of the tube to one end of the plate coil (T) of the coupler, and that the other end of the plate coil is capacitively coupled to the primary and secondary coils through the variable condenser (C2).

In this circuit the choke coil (CK) in the plate circuit prevents the R.F. current from passing through the phones and, therefore, this current follows the path of least resistance, which is to the plate coil (T). As the plate coil is both inductively and capacitively coupled to the secondary or grid circuit, feed-back takes place and regeneration is produced. In this case regeneration may be controlled in two ways; first, by changing the number of turns in the plate coil and, second, by changing the capacity of the condenser (C2). Increasing the number of turns in the plate coil and increasing the capacity of the condenser both tend to increase regeneration by increasing the inductive and capacitive feed-backs, respectively.

MODERN BROADCAST RECEIVERS

Thus far in this article the writer has discussed simple regenerative receiving circuits, but he does not wish the reader to consider using sets of this type for broadcast reception. It is practically impossible to operate a regenerative receiver without causing considerable interference to nearby broadcast listeners. Also, modern receivers are capable of providing much better performance. A five-tube tuned R.F. receiver may be constructed so that it costs very little more than a regenerative set with two audio stages (three tubes in all) and it has many advantages to the listener. It is simpler to operate, the quality of reproduction is much better and the sensitivity is greater.

In order to continue this discussion of the effect of regeneration in tuned, radio-frequency circuits, it is necessary to study the schematic wiring diagram of a typical tuned-R.F. circuit. Fig. 4 presents the wiring diagram of a standard neutrodyne receiver employing two stages of tuned-R.F. amplification and a non-regenerative detector. In this circuit, if the two neutralizing condensers (NC) were removed it would be the wiring arrangement of a standard tuned-R.F. set with no provision for the prevention of regeneration. Therefore, for the purpose of the following discussion, consider the condensers (NC) removed from the diagram.

In the wiring diagram L is the antenna coupler and the two coils L1 are the other radio-frequency transformers. All three coils are the same size, and have the same number of turns on each winding. The two tubes V are radio-frequency amplifiers and V1 is the detector. The three condensers C tune the grid circuits of the three stages.

During reception the three condensers are adjusted so that the grid circuit of each stage is tuned to the same wavelength. The "signal" from the broadcast station is transferred to the grid circuit of the first tube by the antenna coupler and is amplified by that tube; then it is transferred to the second stage by the first R.F. transformer and is again amplified, and then it is transferred to the detector stage by the second R.F. transformer and "rectified" or detected by V1.

The problem in a circuit of this type arises from the fact that the condenser in the grid circuit of each stage must be tuned to the wavelength of the signal in order to obtain maximum efficiency and because the primary and secondary windings of the R.F. transformers are closely coupled to-

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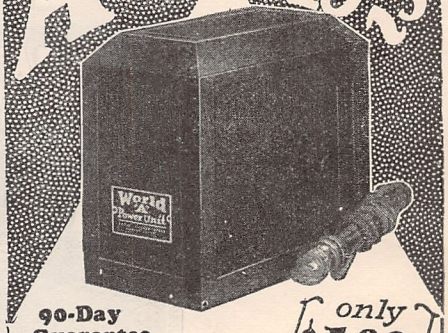

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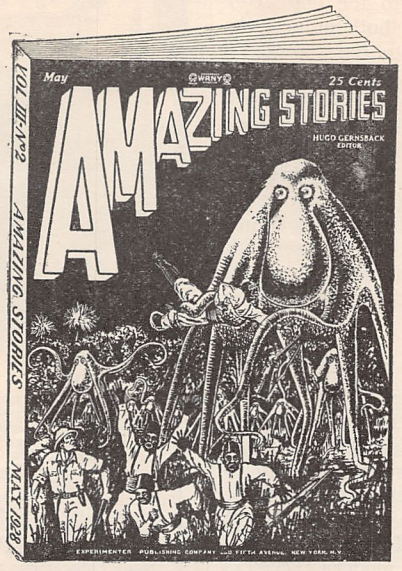

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gether, each primary winding, or plate coil, is automatically tuned to the same wavelength as the secondary. It is, therefore, easy to see that, with the grid and plate circuit of each stage tuned to the same wavelength, the circuit will either oscillate or regenerate, as feed-back will take place through the capacities between the grids and the plates of the tubes, and all the circuits are "resonant" at the same wavelength. It thus happens that, if the circuit is otherwise efficient, it will always oscillate; and it is impossible to control these oscillations and at the same time maintain perfect efficiency.

There are two popular systems for the prevention of oscillation in tuned radio-frequency circuits; the first is known as the neutrodyne system and the second as the "losser" method. There are many different ways in which these methods may be applied; but only the two most popular circuits will be considered in this article.

NEUTRALIZATION

Fig. 4 shows the wiring diagram of a standard neutrodyne circuit. This circuit is exactly the same as a standard tuned R.F. receiver except that two small condensers (NC), which are known as balancing or neutralizing condensers, have been added. It is the purpose of these condensers to nullify the feed-back which takes place through the capacity between the elements of the tube. These condensers are adjusted so that their capacity is approximately equal to the grid-plate capacity of the tubes, and they are connected in the circuit so that they cause an additional feed-back between the plate and grid circuits. However, the interesting feature is that the feed-back through condensers NC is equal in value to, but 180 degrees *out of phase with*, the feed-back which takes place through the elements of the tube. Therefore, it is easy to see that the two feed-backs, one of which is the reverse of the other, will neutralize each other, and the result is a non-regenerative tuned R.F. amplifier.

The second system for the prevention of oscillation is shown in Fig. 5; in this circuit a fixed resistor is connected in the grid circuit of each tube. It is the purpose of these resistors (R) to introduce losses into the circuit and, in this way, prevent the tubes from entering a state of oscillation. The electrical value of these resistors is carefully selected, so that there is just enough resistance in the circuit to prevent oscillation, but not enough to prevent regeneration. Of course, there are many other methods of preventing oscillation with the "losser" method; but the circuit shown is the most popular at the present time and perhaps the most satisfactory. In all cases, however, the efficiency of the circuit is reduced just enough to prevent oscillation.

While both the neutrodyne and the "losser" systems of reception provide a satisfactory receiver for the reception of broadcasting, the "losser" system is more generally used. In a neutrodyne that has been carefully adjusted, both oscillation and regeneration have been eliminated; whereas, with the other system, regeneration has been retained. The facts explained in the early part of this article show that, when regeneration is properly controlled, it is possible to gain much useful amplification with the system. For this reason, with the "losser" system it is possible to obtain greater amplification per stage, greater selectivity, and, if the circuit has been carefully designed,

the results will be equally satisfactory from other viewpoints as well.

THE ROBERTS CIRCUIT

Before concluding this article, it should be pointed out that there is another entirely satisfactory method of obtaining the beneficial effects of regeneration, and known as the Roberts circuit (see Fig. 6). In this circuit a stage of neutralized radio-frequency amplification is combined with a regenerative detector of the type in Fig. 1. Only two tubes are used in the circuit, yet the results obtained usually equal those which may be secured with a three-tube circuit of the type shown in Figs. 4 and 5. This is because the full advantage of regeneration is obtained in the detector circuit and, in addition, there is the amplification of a stage of tuned R.F. Another important feature of the circuit is that, although there is a regenerative detector, the circuit cannot cause interference to nearby receivers because the regeneration is preceded by a neutralized radio-frequency stage.

After a quick glance at the circuit shown in Fig. 6, the beginner may fail to see the relationship between it and the other two circuits mentioned. However, the changes which are present are very slight and do not affect the operation of the circuit. In the circuit of the R.F. tube (V) L, C and NC are identical with the similar parts shown in Fig. 4; and in the circuit of the detector tube (V1) L1 and C perform the same duty as similar instruments in Fig. 1. The coil PL, which is shown, is used only to avoid the necessity of a center tap on the winding of S. C1, CK and VC are employed to lead the plate voltage to the R.F. tube without passing through the primary of L1; but this is not an essential feature of the circuit. VC is a volume-control resistor, CK is an R.F. choke coil and C1 is a fixed blocking condenser.

In Fig. 7 the effect of regeneration on a circuit is illustrated graphically. The low flat curve which reaches an amplification peak of approximately 7 represents the action of a non-regenerative circuit. Notice that the amplification is low and that the circuit is non-selective, as it amplifies almost equally over the wavelengths of several 10-kc. channels. The second curve, which reaches a peak of approximately 15, shows a circuit with a moderate amount of regeneration. It may be seen that both the amplification and the selectivity are greatly increased. The third curve, which reaches a peak of 25, represents a circuit in which too much regeneration is present. The amplification is very high but the selectivity is so great that music would be distorted.

Around the Musical World by Radio

(*Continued from page* 1219)

WHAT NATIONAL MUSIC IS

Now the distinctive music of any country can be divided into three general classes:

(1) National or folk music, which is the fundamental expression of the temperament and the lives of its masses.

(2) Works of native composers, whose music may or may not be distinctively national in character.

(3) Music by foreign composers whose work has been inspired by the general atmosphere, the folk lore, or by the indigenous music of the country itself.

The first two classifications require no explanation, but the third may. As an example of a composer in this class we might take the Russian, Rimsky-Korsakov, who wrote the *Suite Scheherazade*. This beautiful composition is filled with the throbbing melodies peculiar to Arabia, and is said to have been inspired by the *Arabian Nights*.

It is almost impossible to say, with any degree of accuracy, what was the exact nature of the music of the ancient peoples. There is every reason to believe, however, that it expressed their characters, in the same manner as that our modern music is a sidelight on our times and civilization. The compilers of *The Music Map of the World* have briefly set forth a description of the earliest music known to us, the different musical scales used and how long the countries have employed them.

Also the subject of National Music is ably treated. It is a difficult task to explain just what is meant by national music. Generally it is considered to be the folk songs and dances of the inhabitants of a particular country. In this music are reflected the social and political conditions, and the influence of the climate and the scenery of a country.

Covering the Edison Hour programs of this season, *The Music Map of the World* analyzes twenty-one programs of music, each one being devoted to the music of one or more countries. Listeners who tune in WRNY regularly are well acquainted with the Edison Ensemble, who have been on the air for two years. This group of talented musicians will broadcast these programs and those who wish to extend their musical horizon, as well as enjoy delightful concerts, are strongly recommended to tune in these Tuesday evening programs. So that these concerts may be more intelligently enjoyed, a short description of the type of music to be broadcast, and the composers whose works are to be played on each occasion, is given in *The Music Map of the World*. Every lover of music likes to have his own ideas of what the composer had in mind when he wrote the music, and so form his own musical picture. But many times the listeners' imagination is spurred on by reading beforehand something about the country and its composers; so that the music will mean much more in the end.

One of the most interesting features of the book is an inserted map of the world in attractive colors, drawn in the quaint style of the sixteenth century, and on which is indicated by a musical note the birthplace of each of the greatest composers. These composers, together with their dates and birthplaces, are listed alphabetically in the back of the book.

In order that the greatest number of people may be enabled to enjoy this series of programs to the fullest extent, a copy of *The Music Map of the World* will be sent free to anyone who writes to Station WRNY, Hotel Roosevelt, New York City, requesting a copy.

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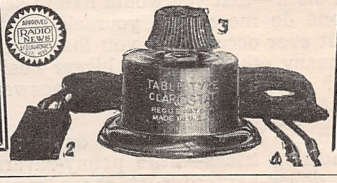

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RADIO NEWS
Editor: THE WHOLE RADIO TRADE
MANAGING EDITOR. HUGO GERNSBACK
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WHAT do you do with your merchandise? Do you hide it away in the back room of your store? Of course you don't. You put it up on shelves in the front, where customers can see it and buy it. You put it there because you know that it will make money for you. And yet are you doing all that you can to increase your sales? Or, is the merchandise that you have so prominently displayed moving as fast as it should? You will probably say that you are doing everything but pull the customers into your store—that you would like to see anyone do more than yourself. But, has it ever occurred to you that there are many others doing a bigger business? Why is this so? The answer is not so difficult.

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The Listener Speaks

(*Continued from page* 1208)

and the office expense, and the dividends of the Curtis Publishing Co.?—the chaps that give up a nickel a copy every Friday? They do NOT!

If the advertiser paying for a program on one of the national chains was not sure that he would get his investment back—and *more too*—from the general public through the purchase of the goods which he so advertises—how long would the present expensive programs continue on the air? *Till the contracts expired—not a minute longer!* Who's getting something for nothing? Not the listening public to which we all belong.

Then, Cuba wants stations "thick and close together"—let him come here—and try for stations below the 300-meter allocation—he'll get them thick and close together—and then some. Perhaps he has one of those selective sets which can tune out three members of a quartet and bring in the soprano as a soloist—freight that set right up to Northern Ohio and stay below 300 meters—and he can have a "cat fight" any time he turns on his set.

If he has a set so selective that it will tune out static, man-made interference, and above all, heterodyning of another station on the same wavelength (alleged) he should send the schematic diagram to RADIO NEWS—it would double their circulation the month it was printed and copies would be at a premium inside of 30 days. Never mind about the 1/10- and 1/15-meter variation—they don't come that close—just to show us how to get one station—clearly—without a whistle when there are five other stations in the country broadcasting on the *same* wave, and your set is a good "DX" receiver. Don't he know that, even in the "cleared band" above 300 meters, there are still heterodyne whistles on certain stations?

The writer has a suspicion that that set in Cuba is able to receive about a dozen United States stations—probably the big ones on the "cleared channels" and experiences no interference or heterodyning, due to inability to pick up the waves of the "little fellows" at all. Let him come here, and learn that he can't even get locals—two miles away—without a whistle from some station in Iowa on the same wave—then see how long he'll vote for stations "thicker and closer together."

The chap in Dakota *ought* to be able to get good reception—he ought not to have any kick—but let both Dakota and Cuba move to any of the first ten cities of this country (where about 50% of the country's population live) and then see if they haven't a real kick coming. They haven't an idea how fortunate they are—right where they're at.

J. E. ROBERTS,
1931 *East 79th St., Cleveland, Ohio.*

A Call From The North

Editor, RADIO NEWS:

I see in the January issue a letter from an Ultradyne fan; I more than agree with him when he says it is a real receiver. In November I pulled in Sydney, 2BL, and Brisbane, 4QG, every morning for a week. Some days the static was bad, but most mornings I was able to bring them in on the loud speaker, loud enough to be heard through the house.

I had to leave on a long patrol with dogs right after that, and have not had the opportunity to work them since, except once when I picked them up as usual. I am expecting verification from them by our next mail from the south. I think all Ultradyne fans should write in and let the world know what a good receiver it is.

I did not get the November copy yet. Our mail in the fall does not get through until open water in the spring; so I did not see the other letters. I am renewing my subscription to RADIO NEWS through the T. Eaton Co. of Winnipeg, as I would not be without it. L. M. LLOYD-WALTERS.
Corporal, Royal Canadian Mounted Police, Fort Smith, Northwest Territories, Canada.

(This letter, though not from the most distant of our readers, took twenty-one days to reach New York, perhaps by dog team to the nearest railway. It may be remarked that Fort Smith, on the sixtieth parallel of north latitude, has very little daylight in midwinter, and consequently, at some time of the 24 hours, almost complete darkness will prevail between this point and any broadcast station in the world—a fact which should facilitate reception. From Fort Smith to Sydney is 8,500 miles, almost entirely over the Pacific Ocean.—EDITOR.)

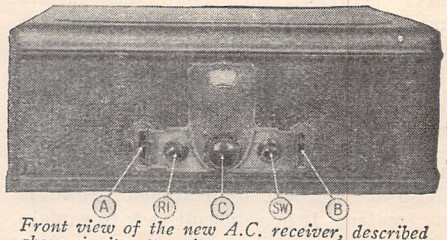
What's New in Radio

(*Continued from page* 1227)

capacity of approximately 30 mf., which is divided into three sections. After the current has been filtered, a resistor bank is used to provide the various voltages required by the tubes of the set.

Another interesting feature of the receiver is the binding post provided for connecting a phonograph pick-up unit; this makes it possible to use the set for the reproduction of phonograph records without removing the detector tube from the socket.

The installation and preliminary adjustments of the receiver are very easily accomplished. It is necessary only to connect the aerial, ground and loud-speaker wires to the necessary binding posts and then insert the tubes in the proper sockets. The only adjustment to be made is for high or low voltage of the power supply; and this is accomplished by simply changing the position of the fuse in the power circuit.



Front view of the new A.C. receiver, described above, in its attractive metal cabinet; C, wavelength control; R1, volume control; SW, switch; A and B, compensating condensers.

Radio-Operated Motor

(*Continued from page* 1240)

(In view, however, of the present vogue of selling stock in companies devoted to the development of mysterious sources of power, the investor should be cautioned that, as yet, the radio motor awaits the invention of a suitable collector of energy to make it profitable. Millions of volts could be picked up by a properly-insulated aerial a few miles above the earth; but the expense of construction would make the (literally) "overhead" cost of such power too great. Should a ray whose ionized path is conductive be discovered, it might be possible to tap the electric energy of the atmosphere; and, similarly, it is suggested that the ultra-short radio waves will make it possible to transmit power in substantial quantities without wires. This would be, not "perpetual motion," but simply exploitation of natural forces, akin to the development of hydro-electric power-generation and transmission. However, all commercial propositions depending on new scientific principles should be required to give demonstrations acceptable to engineers, before they are considered safe for investment.—EDITOR.)

Letters from Constructors

(*Continued from page* 1251)

INTERBALANCED REGENERATION

Editor, RADIO NEWS:

A couple of months ago I built a set, using the interbalanced regenerative circuit outlined by Mr. Barbieri in RADIO NEWS for June, 1927, except that I used transformer coupling in the audio stages. This little set is one of the easiest and nicest tuning hook-ups anyone could ask for, and I have had some very good results on distant stations; having pulled in many eastern ones on the loud speaker.

I found it advisable to put a rheostat in series with the fixed resistor in the filament circuit of the R. F. tube; as I can get all the locals with plenty of volume and selectivity on the detector and audio stages. One improvement I made might help some other readers who are using this circuit. When I first built the set I used a 10,000-ohm variable resistor as recommended for the regeneration control. However, there were two things I did not like about this; in the first place, the regeneration was increased by turning the knob to the left, which did not seem natural. In the second place, the set would break into violent regeneration without any warning when nearing the oscillation point. I found an old potentiometer, of probably 400 or 500 ohms, which made a wonderful improvement over the resistor. Regeneration is now increased by turning the knob to the right; while the control is much less critical and set gives a gentle warning plop before violent regeneration starts.

RADIO NEWS is certainly a very fine magazine and I look forward to every issue.

D. C. DE HART,
567 *Camino del Mar, San Francisco, Calif.*

A CHANGE ON THE B.-D.

Editor, RADIO NEWS:

I have been experimenting with the Browning-Drake circuit, using the phasatrol system of neutralization, with 201A tubes and home-made coils. I find that connecting the "B+" end of the primary to ground seems to increase sensitivity, selectivity and volume. I would like to hear from some of the home set constructors who try this arrangement, and the results they get.

RALPH A. MOORE,
215 *West Clark St., Livingston, Mont.*

(*The designers of this circuit have already come to the same conclusion, a fact unknown to Mr. Moore when he wrote. The condenser between the R.F. tube plate and the primary makes this arrangement possible.*—EDITOR.)

IN AUSTRALIAN SUMMER

Editor, RADIO NEWS:

I have just built the short-wave receiver described in your issue of October, 1927. It delivers the goods, all right, and I can certainly recommend it to anyone requiring a receiver easy to build and sure in results. I completed this receiver just in time to log in 5SW (Chelmsford, England) relaying 2LO (London) last Thursday night and, although reception was not good, it was no fault of the receiver. Every night since then I have tuned in the Russian station RFN between 8 and 9 p. m. and get the most perfect reception on the loud speaker. They transmit on 60 meters, very good programs; and, as you did not include it in your earlier list of short-wave stations, I thought it worth mentioning.

Last night I had beautiful reception from PKXX, Java, using a Bremer-Tully coil of two turns. It may be of interest to know that the receiver oscillated with this coil, using the transformer secondary. I then replaced it with a 5-megohm grid leak, but found results not so good. Just in passing, I may add that I used a B.-T. coil kit, purchased Karas condensers, with which I had previous experience, and an Australian product, "Advance" transformers; and the quality of the reception is all that could be desired.

I will now make an effort to log your side of the world with your short-wave set, and I want especially to get WRNY. From 5 to 7 a. m., our time, is best; but as I am busy now, being a farmer, I will have to let it go for a while. Melbourne's 3LO transmits every Monday morning on 33.5 meters from 4 to 6 a. m. They are being well received in England, and you should log them in between 1 and 3 p. m. on Sundays.

I think RADIO NEWS is the best production of its kind, probably in the world; and any special circuit put out by it is bound to be good. I have owned or handled many sets; among them the L2 which came out in RADIO NEWS a few years ago, and will take a lot of beating today. Also, through an advertisement, the Norden-Hauck, with which I logged KDKA and KGO's long waves. It may be of interest to you to know that on this side we like RADIO NEWS circuits.

PEARSON L. SUTTON,
Windermere, Piallamore, via Tamworth, New South Wales, Australia.

APPRECIATES HELP

Editor, RADIO NEWS:

I would like to say a good word for one of your contributors, Mr. C. A. Oldroyd of England. Some time ago I built a Browning-Drake set, winding the coils according to the specifications by Mr. Oldroyd in the December, 1926, and January, 1927, issues. I could never get it to work properly, although I wired it three times. After trying several other sources, I wrote to Mr. Oldroyd about it. Two days ago I was delighted to receive a very interesting letter from him, giving all the information I needed and an invitation to write him again as to the results.

I have been building sets since 1922, and have not missed many issues of RADIO NEWS during that time.

E. R. WILBANKS,
5210 *Acadia Terrace, Fairfield, Alabama.*

GOOD WORK ON FIVE TUBES

Editor, RADIO NEWS:

I am using a T. R. F. 5-tube set, the Nakken autotransformer circuit; home-built of course, as this set has not been developed commercially. (RADIO NEWS for October, 1926.) All last summer I received Davenport, St. Paul, Chicago, Cleveland and New York in daytime; and the reception was so regular and so ordinary that I did not bother to get confirmations. So I cannot prove it if called upon, but yet it is true. Using this circuit, I have received with great volume and clarity a 10-watt station in Harrisburg, Illinois (WEBQ)—not in daylight, however.

My aerial and ground are, if anything, somewhat inferior to the average; as the aerial is only about 40 feet, exlusive of lead-in, and the ground a cold-water pipe, with the connection 25 feet from the ground and on the house side of the meter. Moreover, the tubes I am using are over two years old, and of the so-called "bootleg" variety.

So, figuring my handicaps, to which may be added a not very stable source for my "B" power unit, I feel very confident that there is something wrong with Mr. Woodruff's superhet.

Just last evening I listened for an hour to WWRL, a 100-watt station at Woodside, New York, for an hour; and it was as loud and good as KDKA is on most factory-built sets. I listened to KFI for two hours on the first three tubes (using phones, as the Mrs. was asleep) with no interference from WSB and no particular fading. The other—daylight—reception I speak of was all on the loud speaker.

There are times, naturally, when I would sell my set for a dime; times, even when I would pay to have it removed. But, take it on the whole, Mr. Nakken has sort of put the superhet under

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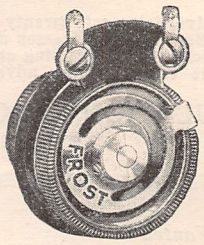

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Something new—signals one hundred cycles apart separated. Seventy-five per cent static eliminated. Particulars. Write, Box 1116, Riverhead, New York.

Musical

Play Piano by Ear. A sound system. Booklet free. Boucher's Harmony Studio, 12, Ottawa, Canada.

Old Money Wanted

$2 to $500 each paid for hundreds of Old or Odd Coins. Keep all old money, it may be very valuable. Send 10c for New Illustrated Coin Value Book, 4x6. Guaranteed prices. Get posted. We pay Cash. Clarke Coin Company, 14 Street, LeRoy, N. Y.

Patent Attorneys

Mason, Fenwick & Lawrence. Washington, D. C., New York and Chicago. Established 1861. Inventions protected, trade-marks registered. Information given—write promptly.

Patents—Send for form "Evidence of Conception" to be signed and witnessed. Form, fee schedule, information free. Lancaster and Allwine, Registered Patent Attorneys in United States and Canada, 269 Ouray Bldg., Washington, D. C.

Patents—Send drawing or model of your invention for examination and instructions. Advice and booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 724 9th Street, N.W., Washington, D. C.

Inventors—Should write for our Guide Book, "How to Obtain a Patent" and Record of Invention Blank. Send model or sketch and description of inventions for Inspection and Advice Free. Radio, Electrical, Chemical, Mechanical and Trademark Experts. Terms Reasonable. Victor J. Evans & Co., 922 Ninth, Washington, D. C.

Patent Sense—Valuable book free. See Lacey's ad, page 1279. Lacey & Lacey, 631 F. St., Washington, D. C. Established 1869.

Wanted, Ideas. Demand for novel devices, however small. If patentable, may be the means of your independence. Patents obtained. Sales negotiated. Advice free. INVENTORS SERVICE BUREAU, Box 1648, Washington, D. C.

Patents

Inventions Commercialized. Patented or unpatented. Write Adam Fisher Mfg. Co., 278 Enright, St. Louis, Mo.

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200 Letterheads and 100 Envelopes, $1.10, postpaid. OBERMAN COMPANY, Box 1268, Chicago.

Printing Outfits and Supplies

Print your own cards, stationery, circulars, paper, etc. Complete outfits $8.85; Job Presses $11, $29; Rotary $149. Print for others, big profit. All easy, rules sent. Write for catalog presses, type, paper, etc. Kelsey Company, F-13, Meriden, Conn.

Radio

Press and public concede it to be the best ever produced. "Radio Theory and Operating," by Mary Texanna Loomis, member Institute of Radio Engineers, Lecturer on radio. Loomis Radio College. Thorough text and reference book; 886 pages, 700 illustrations. Price $3.50, postage paid. Used by Radio Schools, Technical Colleges, Universities, Dept. of Commerce, Gov't Schools and Engineers. At bookdealers, or sent on receipt check or money order. Loomis Publishing Company, Dept. B, 405-9th St., Washington, D. C.

Raytheon Kits $17.75, UX 281 Kits $25.75. Write for diagrams and material lists. Radio Parts Sales Co., Orange, N. J.

Phenomenal new crystal set. Guaranteed 1,000 miles, and loud-speaker reception or money back. $2.95, cash or C. O. D. McKay Instrument Co., Railway Exchange Building, Portland, Oregon.

Write about our efficient power devices. KIMLEY ELECTRIC CO., 441 E. Ferry, Buffalo, N. Y.

Be the licensed **Radio Doctor** of your community. $7-$10 spare time evenings. Our co-operative plan procures all the work you want. Secure franchised territory now. Write for booklet. Co-Operative Radio Doctors, Dept. N, 131 Essex St., Salem, Mass.

Salesmen Wanted

A paying position open to representative of character. Take orders shoes, hosiery, direct to wearer. Good income. Permanent. Write now for free book, "Getting Ahead." Tanners Shoe Mfg. Co., 874 So. C. St., Boston, Mass.

A Good Line: Suitable for all or part-time. Can be sold in big cities or small towns; any place. Every business house needs envelopes in different sizes, weights and qualities. Many buy in large quantities. Our line includes stationery, and is very complete. The samples are flat, carry easily, weigh little, look good; prices reasonable. Commission liberal and paid promptly. You would like our offer. **American Envelope Company,** Mexico, Missouri.

Scenery to Rent

World's Most Beautiful settings for operas, plays, minstrels. Amelia Grain, Philadelphia.

Song Writers

Song Writers—Substantial Advance Royalties are paid on publishable work. Anyone having original ideas for songs may submit poems for examination and free advice. Walter Newcomer, 1674 Broadway, New York.

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Telegraphy—Both Morse and Wireless taught thoroughly. Big salaries. Wonderful opportunities. Expenses low, chance to earn part. School established fifty years. Catalog free. Dodge's Institute, Cour St., Valparaiso, Ind.

Wanted to Buy

Full Value Paid for Old Gold, Jewelry, Watches, Diamonds, crowns, bridges, dental gold, silver, platinum, gold or silver ore; magneto points, old false teeth. Packages returned if our offer is not satisfactory. United States Smelting Works (The Old Reliable), 39 So. State St., Dept. 16, Chicago, Ill.

a cloud with me. Tube for tube, and not excepting regeneration, I do not believe any circuit has developed which could touch this autotransformer thing. I will except the Strobodyne and Hilodyne—as I have been unable, to date, to see or hear either one.

It isn't entirely a question of "how much" circuit, nor is it entirely "what kind?" There is a very great deal in this; how good are your connections, and how much excess copper is in the wiring?

I would like to know whether the lady in St. Louis *did* hear the song dedicated to her in Chicago. It's more than an even chance she did.

R. H. LITTLE,
94 *Millview Street, Uniontown, Pa.*

STANDARD-FREQUENCY TRANSMISSIONS

The summer schedule of official standard-frequency (code) transmissions from station WWV, Bureau of Standards, Washington, D. C., follows. Readers unfamiliar with these and the methods of calibrating instruments by them may, if interested, obtain Letter Circular No. 171, with full instructions, on application to the Bureau.

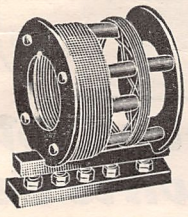
Times given are Eastern Standard. Figures above, kilocycles; (below in parenthesis, approximately, meters) of the transmissions.

Hours P. M.	April 20	May 21	June 20	July 20	Aug. 20
10:00	3000	650	1500	3000	125
10:08	(100)	(461)	(200)	(100)	(2400)
10:12	3300	750	1650	3300	150
10:20	(91)	(400)	(182)	(91)	(2000)
10:24	3600	850	1800	3600	175
10:32	(83)	(353)	(167)	(83)	(1714)
10:36	4000	950	2000	4000	200
10:44	(75)	(316)	(150)	(75)	(1500)
10:48	4400	1060	2250	4400	225
10:56	(68)	(283)	(133)	(68)	(1333)
11:00	4900	1200	2500	4900	250
11:08	(62)	(250)	(120)	(62)	(1200)
11:12	5400	1350	2750	5400	275
11:20	(56)	(222)	(109)	(56)	(1091)
11:24	6000	1500	3000	6000	300
11:32	(50)	(200)	(100)	(50)	(1000)

Radio News Laboratories

(*Continued from page* 1253)

primary and secondary are supported by four celluloid rods 5/16-inch in diameter and 2-5/16 inches long; these rods are attached to two flat celluloid rings 3 inches in diameter and, together with the base which carries five small plugs, form a rigid

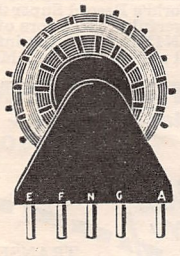


frame for the transformer. The primary slides over the supporting rods, thus making possible to adjust its coupling with the secondary. The secondary is tapped at 15 turns and has an inductance of approximately 220 microhenries.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2323.

R.F. TRANSFORMER

The long-wave plug-in transformer shown here comprises three basket coils mounted on the same frame; one for the primary and the other two for



the secondary. This radio-frequency transformer may be employed for long-wave reception in radio receivers using the radio-frequency plug-in coil described above. Like the three preceding items, it is of Austrian manufacture.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2324.

I Want to Know

(*Continued from page* 1256)

this plate. The lug should be provided with a tight-fitting rubber tube generously covered with vaseline, to prevent sparking at the point where it leaves the solution. This lug can be cut as shown in the diagram; so that it will not be necessary to waste very much material in order to get this connection.

Types of Electrolytic Condensers

By referring to Fig. 2277B you will note that there are two general types of electrolytic condensers. The first (1) is to be used with alternating-current circuits and contains two sets of plates, arranged alternately in the electrolyte. In this case, the condenser should be "formed" with alternating current so that both sets of plates will have a film over their surfaces. The other (2) is the D.C. type and contains one set of aluminum plates and a lead plate. The lead plate serves only to make an electrical contact with the electrolyte, and should always be used as the negative terminal. This is the type of condenser to be used in "B" power units and other circuits supplied with direct current. An ordinary glass battery-jar or a large mason jar can be used as a container; although if the latter is employed it may be necessary to have more than one cell in order to obtain sufficient capacity for the circuit. When used in "B" power units, these condensers must be "formed" with voltages higher than the output voltage of the rectifier tube, so that the condenser will not break down. Because of this, the capacity obtained is not as great as that of a condenser used for low-voltage work.

To "form" the plates of the condenser, it should be placed across a suitable current supply—either D.C. or A.C., depending upon the condenser—and should be left in the circuit for about 24 hours. A forming voltage should be applied which is somewhat above the maximum voltage that is to be applied to the condenser.

When low-voltage condensers are to be made, a system such as the one shown in Fig. 2277B at (3) should be used. The potentiometer should have rather high-resistance and be capable of dissipating the heat generated through its resistance strip.

Probably the most common electrolyte used, is sodium biborate, or borax as it is commonly called. A saturated solution of this chemical should be made and a small amount of glycerine should be added.

One of the main reasons why chemical condensers and rectifiers have not become more popular is because of the sloppiness and the necessity of renewing the water in the solution. At different times experiments have been made with a number of so-called "jelly" electrolytes, including fused sodium phosphate and several other chemicals. However, these jelly rectifiers have not been successful because, as the water evaporates, the jelly falls away from the electrodes; thus stopping the action.

CAN YOU "BEAT" IT?

I TELL YOU I'VE JUST BEEN ROBBED
HUSH! I'M LISTENING TO A SYMPHONY
NEW JERSEY POLICEMEN ARE TO BE PROVIDED
WITH WIRELESS SETS COMPLETE WITH ALL ACCESSORIES.
GO ROUND THE OTHER WAY YOU'RE SHAKING THE CATSWHISKER OFF MY CRYSTAL
IF THE IDEA SPREADS IT MAY COMPLICATE THE TRAFFIC PROBLEM
ANYWAY THE LATE DANCE MUSIC WILL BE APPRECIATED BY THE P.C. ON NIGHT DUTY.
AND HE OUGHT TO BE ABLE TO CHARGE HIS OWN ACCUMULATOR.
THE PRISONER IS CHARGED WITH BEING RUN DOWN AND DISORDERLY ON DUTY SIR.
Gen Sham

—*The Wireless Constructor* (London)

180 VOLT "B" ONLY $12.45

Now—you can buy as good a "B" Eliminator as it is possible to build—at a price that won't cramp your purse. And you buy the PEERLESS without risk of any kind, for it is yours to try 30 days and it is

GUARANTEED 2 YEARS This astounding offer is without precedent. Think of it! A "180" volt "B"—a "B" that will run your set and a type 171 power tube, too—and guaranteed for two long years—at the ridiculously low price of only $12.45.

For 110 Volt 50-60 Cy. A-C

Tube Free

The regular price of the PEERLESS is $12.45 without the tube. But, as a special offer to get thousands of these units out on set, we will include, for a limited time only, a genuine $4.50 Q.R.S. 85 Mil. Tube free with your order.

$1 DOWN MAIL COUPON

Send only $1.00. A dollar bill will do. We'll ship the PEERLESS "B" at once. Pay the expressman $11.45 plus small express charges. Remember—you order the PEERLESS entirely at our risk. 30 days free trial. *Money back guarantee* protects you. Order NOW.

PEERLESS MFG. CO., 3983 Cottage Grove Ave., Chicago, Ill.

GUARANTEE COUPON

PEERLESS MFG. CO. 3983 Cottage Grove Ave., Chicago

I enclose $1. Send me one Peerless 180 volt "B" Eliminator and one $4.50 Q.R.S. 85 Mil. Tube. I agree to pay expressman $11.45 plus small express charges. It is understood I can have my money refunded if not satisfied.

Name.....

Street.....

Town.....*State*.....

Changes Your Set Into a Short-Wave Receiver

Sent postpaid anywhere in U. S. upon receipt of $15.00 M. O., or C. O. D. plus postage, upon receipt of $1.00 to guarantee carrying charges.

When ordering state kind of set so that detailed directions for use may be given if necessary. Also state type of tubes, such as UX199, UV199, WD11, or 201A.

The SUBMARINER

Regardless of the kind of set you have, this device will permit you to listen to short-wave stations between 26 and 68 meters. Operates with sets such as T. R. F., Neutrodyne, Super-Heterodyne, regenerative sets, and many other types. No additional tubes or batteries required. No changes to the wiring of the set. A short aerial and ground is connected to the "Submariner," and a cable and plug attaches it to the set. Requires less than a minute to attach or detach. Operates as a wave changer with Super-Heterodynes, and as a detector unit with others.

SHORT-WAVE RECEPTION

Is practical because they penetrate better, and there is less static. There are several powerful stations using the wave band covered by the "Submariner" for broadcasting programs. You may also learn code by listening to amateurs from all parts of the world. You will have a highly efficient short-wave receiver when the "Submariner" is attached to your set. Nothing else like it on the market. Take a trip in the low waves on board the "Submariner."

ORDER TODAY

We guarantee to refund if the "Submariner" fails to operate

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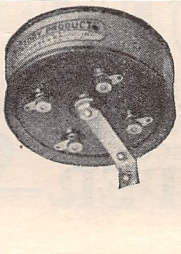

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Super Coils

Send for Folder and our Blue Print of the new A. C. circuit.

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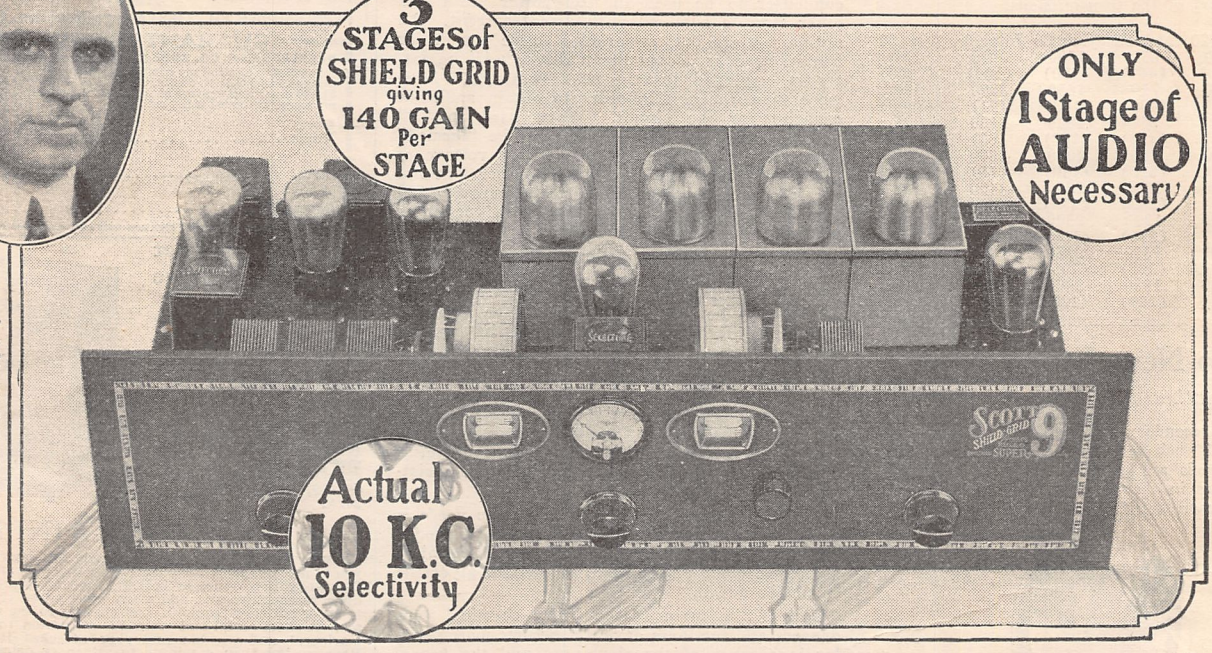
A GREAT, NEW RECEIVER

SCOTT CHALLENGES THE WHOLE WORLD OF RADIO TO ANY KIND OF COMPETITIVE TEST

E. H. SCOTT

The New Scott Shield Grid 9 was designed by E. H. Scott, designer of the World's Record Super 10, which prior to the advent of this new model held all records for Radio set performance.


3 STAGES of SHIELD GRID giving 140 GAIN Per STAGE
ONLY 1 Stage of AUDIO Necessary
Actual 10 K.C. Selectivity
SCOTT SHIELD GRID 9 SUPER

More Actual Amplification • More Distance and Volume than Any Other Existing Receiver Known to Us

This—we believe, is the most powerful, the most selective and the finest toned receiver in existance today. We draw this conclusion from having tested and scientifically measured every other receiver which might claim itself the equal of the SCOTT World's Record Shielded Grid NINE. And there is no question but that this radically new type of receiver will maintain its position of obvious superiority for years to come, for the features of circuit engineering responsible for its amazingly better performance are far ahead of any circuit developed to date.

UNLIMITED RANGE! Without aerial, ground or loop, the SCOTT Shielded Grid NINE brings Pacific Coast Stations to Chicago with loud speaker volume. And so tremendous is the amplification of the *shielded grid* long wave amplifier employed, that it is impossible to determine a range limit for this receiver when used with a short antenna and a connection to ground.

Shielded Grid Tubes Used in an Entirely New Way

Standard circuits commonly in use with the new shielded-grid tubes, provide actual amplification of approximately 40 per stage. The revolutionary new circuit used exclusively in the SCOTT Shielded Grid NINE, gives a practical amplification of 140 per stage, thereby making this receiver many times more powerful than receivers using shielded-grid tubes in a conventional manner. It is this new circuit arrangement developed and used exclusively by us which enables us to challenge the whole world of radio to any kind of competitive test with assurance that the SCOTT Shielded Grid NINE will win.

Only One Stage of Audio Required!

The second detector output of this receiver is so heavy that concert volume and clear, undistorted cathedral tone, even on the most distant stations, is obtained with but a single stage of 2 to 1 audio frequency amplification.

Easy to Build --- Results Guaranteed

Despite the fact that the Scott Shielded Grid NINE is one of the most elaborate receiving systems ever devised — and despite the fact that it embodies many features of circuit arrangement not known to common practice, it is a very easy set to build, and when you buy the kit of parts we positively guarantee that you will get the same results we get from our laboratory model. Both panel and sub-panel are drilled to receive each part and the shield-grid amplifier units come to you fully wired and tested—ready to be connected into the circuit just as though they were a transformer.

Why Pay More *for* Less?

Why pay more than the small cost of the Scott Shielded Grid NINE when no other receiver offers you so much? Why not have a receiver which provides actual 10 Kilocycle selectivity regardless of where located? Why not have a receiver with which you can listen in on all the world—no limit to its distance range. The Scott Shielded Grid NINE is, unquestionably the finest, most powerful, most advanced receiver of the day, and is, beyond all doubt, destined to hold its position of leadership, throughout the coming years. It is the ultimate. Build it—enjoy it NOW.

FREE

Circuit Diagram and Particulars

Find out all particulars of the Scott Shielded Grid NINE. Examine its circuit. See for yourself why it has unlimited range—unlimited power—perfect tone. Proof of the superiority of this great new receiver is FREE to you. Also copies of 6000 and 9000 mile reception verifications and other records made by the Scott World's Record Super 9 and the Super 10, the less powerful predecessors of the new Scott Shielded Grid NINE. Get this information now. Simply clip and mail the coupon. Mail it TODAY!

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Send me full particulars of the new Scott Shielded Grid NINE.

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